

**ARMED FOR SUCCESS: EXTERNAL FACTORS
OF THE WORLD WAR I ACES**

**A thesis presented to the Faculty of the U.S. Army
Command and General Staff College in partial
fulfillment of the requirements for the
degree**

MASTER OF MILITARY ART AND SCIENCE

by

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 2 June 1995	3. REPORT TYPE AND DATES COVERED Master's Thesis, 2 Aug 94 - 2 Jun 95	
4. TITLE AND SUBTITLE Armed for Success: External Factors of the World War I Aces			5. FUNDING NUMBERS	
6. AUTHOR(S) Major John P. H. Rayder, U.S. Marine Corps				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Command and General Staff College ATTN: ATZL-SWD-GD Fort Leavenworth, Kansas 66027-6900			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution is unlimited.			12b. DISTRIBUTION CODE A	
13. ABSTRACT (Maximum 200 words) This thesis examines the external factors relating to the success of the World War I Aces. Five representational figures were chosen and five external factors were evaluated through historical analysis. The representational figures are Hauptmann Oswald Boelcke (Germany), Captain Rene Fonck (France), Colonel William "Billy" Bishop (Canada), Major Edward Mannock (Great Britain) and Captain Edward V. Rickenbacker (United States). The external factors include background, combat environment, aircraft, opportunity for tactical innovation, and training opportunity. This study provides five conclusions regarding the World War I Aces and the effects of their external factors. First, they came from radically diverse social and economic backgrounds. Second, their combat environment was dynamic in nature. Third, their aircraft were generally equal to, if not superior, than their adversary's. Fourth, an opportunity for tactical innovation existed; however, the Aces responded in two sharply contrasting ways. Specifically, some persisted in individual combat and personal recognition, while others achieved success while developing formation tactics and air combat pilot training. Fifth, the Aces were largely responsible for their own training.				
14. SUBJECT TERMS Aces, Boelcke, Fonck, Bishop, Mannock, Rickenbacker, Tactics, Training, Aircraft, World War I			15. NUMBER OF PAGES 95	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited	

DTIC QUALITY INSPECTED 5

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THESIS APPROVAL PAGE


Name of candidate: Major John P.H. Rayder

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War I Aces

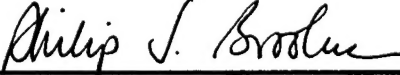
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ABSTRACT

ARMED FOR SUCCESS: EXTERNAL FACTORS OF THE WORLD WAR I ACES by MAJ
John P.H. Rayder, USMC, 88 pages.

This thesis examines the external factors relating to the success of the World War I aces. Five representational figures were chosen and five external factors were evaluated through historical analysis. The representational figures are Hauptmann Oswald Boelcke (Germany), Captain Rene Fonck (France), Colonel William "Billy" Bishop (Canada), Major Edward Mannock (Great Britain) and Captain Edward V. Rickenbacker (United States.) The external factors include background, combat environment, aircraft, opportunity for tactical innovation and training opportunity.

This study provides five conclusions regarding the World War I aces and the effects of their external factors. First, they came from radically diverse social and economic backgrounds. Second, their combat environment was dynamic in nature. Third, their aircraft were generally equal to, if not superior, than their adversary's. Fourth, an opportunity for tactical innovation existed; however, the aces responded in two sharply contrasting ways. Specifically, some persisted in individual combat and personal recognition, while others achieved success while developing formation tactics and air combat pilot training. Fifth, the aces were largely responsible for their own training.

To my father, who helped me build my first aircraft model.
Just before I broke it.

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LIST OF ABBREVIATIONS

RAF	Royal Air Force
RFC	Royal Flying Corps
RNAS	Royal Naval Air Service

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CHAPTER 1

INTRODUCTION

Introduction

Research of the evidence indicates that external factors contributed to the success of the World War I aces, as exemplified by Hauptmann Oswald Boelcke, Captain Rene Fonck, Colonel William "Billy" Bishop, Major Edward Mannock, and Captain Edward V. Rickenbacker. These external factors are contained within the categories of: background, combat environment, aircraft, opportunity for tactical innovation, and training opportunity. Information identifying the extent to which each of these external factors participated in producing these individuals' success is not readily available.

Historical analysis of the record in a new way enlightens the body of knowledge. The subject of World War I air combat, generally over-romanticized, would certainly benefit from a fresh approach. Additional benefits from such analysis include an increase in understanding of the external factors which contribute to success in air combat and an increase in understanding of the influence these external factors held during World War I.

Problem Statement

A comprehensive study identifying external factors and their influence on the success of the World War I aces has not been accomplished. Detailed examination of these external factors would serve to fill a gap in the body of knowledge.

Research Question

What common external or non personal factors contributed to the success of the World War I aces? What were the aces' backgrounds, i.e., their social and economic status, education, personal interests, and influences? What were the aces' combat environments, i.e., the duration of their involvement, timing, mission profiles, engagement areas, and general conditions? Of the aircraft that the aces flew, what were the speed, service ceiling, and armament capabilities and limitations; and, to what extent did the aces exploit these? Did the opportunity for tactical innovation present itself? Were the aces' tactics taught or learned; and, were they effective? What training opportunities were available to the aces? Did the aces contribute to combat training? What type of training did the aces receive before and during the war?

Background

The development of fighter aircraft and air combat tactics during World War I was the natural evolution of warfare resulting from the introduction of new technology and the aggressiveness with which it was exploited. Once the importance of aerial reconnaissance and aerial artillery spotting was realized, the requirement to counter this threat soon followed. Inevitably air combat encounters occurred, producing victors and the vanquished. Victories mounted for individual pilots, and nations, weary from a stalemated ground war of attrition, followed the success of these "aces." Representing approximately 5 percent of the total of those who fought in the skies over the trenches of World War I, these aces accounted for 40 percent of the victories.

The French are credited with being the first to recognize the accomplishments of their scout pilots and introduce the ace designation system. In France, during this period, the term "ace" was liberally applied to anyone, particularly athletes, who had accomplished something unusual. In early 1915 the French pilot Roland Garros achieved five air combat victories in sixteen days and, like other French heroes, was proclaimed an "ace" in the headlines. An American reporter in Paris assumed that the ace designation was directly related to the accomplishment of five air combat victories by a Frenchman and reported as such. The Germans applied the term "Kanone" (cannon or weapon) to a pilot accredited with ten or more victories. Great Britain was resistant to singling out individual success, and the British public was generally only informed of its pilots' air combat accomplishments through documentation of their decorations.¹ In all, 1,500 World War I pilots, more than one-half of them from Great Britain, individually scored five or more kills, obtaining the title "ace." Germany followed with 363 aces, and France with 160. The United States produced 110 aces, although many of these pilots had proved successful with the French or British prior to the United States' entry into the war.²

World War I and its aces are historically important because of the aircraft's evolution as a weapon and the development of air combat missions, tactics, technology, and leadership. The magnitude of the air war in World War I is often underestimated. World War I was indeed a mature air war and is worthy of study. The war ended with the loss of over 100,000 total aircraft: by the Germans, 27,637; by the British, 35,973; and by the French 52,640. Aircrew deaths totaled over 55,000.³

The fighter pilot is the culminating component of an airborne weapons system. As such, he must assimilate information, accurately assess the current situation, and take offensive action to accomplish his mission. Historical analysis has been accomplished to record the effects of aircraft design and technological evolution on mission capability and tactics development during World War I. But although the ace represents the pinnacle of air combat success, little is recorded regarding the effects of external factors upon his success. The issue of innate qualities of skill and capability of the aces has been adequately, although broadly, described as "situational awareness." "[Situational awareness] is a combination of many things, but in essence it is the ability of the pilot to keep track of events and foresee occurrences in the fast-moving, dynamic scenario of air warfare."⁴ The fighter pilot is a product of his environment with the combination of various personal skills, innate capabilities, opportunities, and external factors producing individual success. Extensive studies have been accomplished to further define situational awareness and like human qualities; however, research of those external factors within the equation is limited. Analysis of external factors and their influence upon the success of the World War I aces is, therefore, worthy of study.

Definitions

Ace. A pilot who has obtained five or more confirmed air combat victories.

Advantage. A fighter has the advantage when the target aircraft is within the fighter's weapons employment range and the fighter has the capability to establish, through aircraft positioning, sufficient lead. A World War I fighter with an altitude advantage

over his adversary had a significant positional advantage. Because of the poor rate of climb performance and limited weapons employment ranges (machine gun) of the World War I fighters, the higher aircraft could use the altitude advantage as turning room, not available to the lower aircraft, and establish a desired firing position, while avoiding his adversary's weapons. Altitude, as potential energy, additionally offered the higher aircraft the opportunity to "trade altitude for airspeed" and accelerate to its maximum velocity in a diving attack. A fighter employing this technique could complete his firing pass and quickly escape from the local engagement area.

Flying Circus. German fighter squadrons/groups known for their colorful individualistic paint schemes and lethality.

In The Sun. Use of the sun was an effective tool of the successful World War I fighter pilot. To be "in the sun" a fighter pilot maneuvers his aircraft to a relative position between the sun's brilliance and his target, thereby masking his approach.

Kill. Destruction of an enemy aircraft resulting from air combat.

Lead. The required distance that a weapon must be aimed in front of a target to account for: target range, target crossing velocity/line of sight rate (function of fighter's angle off the target and the target's own velocity), bullet velocity, gravity, and relative velocity (opening/falling back or closing/overtaking). This is a difficult skill to acquire and one which Rene Fonck is credited with mastering. Most other aces advocated firing from extremely close range, thereby greatly reducing the lead requirements and possible errors.

Maneuverability. An aircraft's agility in air combat in relation to its adversary's, generally determined through comparisons of aircraft turning ability, pitch rate, and other control characteristics. (See turn rate and turn radius).

Merge. That position in space, at which flight paths of two or more aircraft, traveling in opposite directions, and in close proximity to each other, initially intersect. Merge is also known as the pass. The destruction of one's adversary premerge is highly desirable because it reduces the time to kill, thereby limiting the fighter's vulnerability in the engagement area.

Pusher. World War I aircraft type with aft-mounted engine.

Scouts. World War I fighters.

Tractor. World War I aircraft type with forward-mounted engine.

Turn Radius. The radius of the flight path circle that an aircraft scribes when turning. In contemporary terms, it's measured in feet. A World War I fighter that could fly a smaller circle had the advantage of being able to "turn inside" of its adversary.

Turn Rate. In contemporary terms, it's the measure of heading change in degrees over a specified time (seconds). Practically, it is how fast, in relation to another aircraft, a fighter can turn. A World War I fighter with a faster turn rate had the advantage of "out turning" its adversary and could employ its fixed machine gun first.

Limitations

Research has been limited to historical records and accounts. No aces from World War I are alive today to give personal interviews.

Delimitations

An exhaustive analysis of 1,500 World War I aces is not feasible; therefore, the number of aces has been limited to five representational figures. The criteria for their selection as being representational of their respective countries are that they performed in combat over an extensive period of time, were leading performers, and provided leadership in the development of their air services. These aces include: Hauptmann Oswald Boelcke, Germany; Captain Rene' Fonck, France; Major William Bishop, Canada (RFC); Major Edward Mannock, Great Britain; and Captain Edward V. Rickenbacker, United States. Each of these individuals was his country's leading ace in World War I, with the exception of Boelcke. While not the leading German ace, Boelcke's impact on German aerial combat in World War I is immeasurable.⁵

Significance of Study

This thesis will serve to document the impact of external factors on fighter pilot success through examination of representative individual World War I aces. By increasing the understanding of external factors and their contribution to success in air combat during World War I this study accomplishes three objectives: First, it serves to fill a gap in the body of knowledge, specifically, identification of air combat external factors and their influence during World War I; second, it provides analysis of common external factors effecting the success of individual World War I aces; and finally, an understanding of the external factors which contributed to the success of a specific group of individuals in history may assist in an understanding of the external factors effecting today's warriors.

CHAPTER 2

LITERATURE REVIEW

A preliminary review of the literature, relating to this thesis topic, indicates that there is nothing on record which deals specifically with the effect external factors had upon the success of the World War I aces. There are, however, numerous works providing information pertinent to a study of the World War I aces and the external factors which effected their success. These sources fall into three general categories: the aces' individual experience, historical references, and reference material detailing technical information.

The external factors of background, combat environment, aircraft, opportunity for tactical innovation, and training opportunity cannot be isolated in any individual category of material. Each category provides individual insights which collectively are relevant; however, they fail to adequately address the effect of the aces' external factors. This thesis fills this gap through its determination of relevance and influence, thereby providing the hub to which each spoke of information connects.

The Aces Experiences

The aces' individual experiences generally follow from two documented forms: autobiographies and biographies constructed from personal letters and interviews with squadron mates. These are instrumental in analyzing the perceptions and thought processes of the

individual aces. However, they are most helpful in the research of the identified external factors. These works provide the best account of the aces' background, perceptions of aircraft capabilities and limitations both theirs and the threats-general perceptions of the environment they flew in, daily mission requirements, their view on air combat opportunities, evaluation of the opponents they faced, tactics that they employed and encountered, and accounts of the training they received. Autobiographical/biographical information of additional aces helps to establish the presence or lack of doctrinal thought.

The biography Knight of Germany: Oswald Boelcke, German Ace by Johannes Werner proved to be the best source of information on Boelcke, with An Aviators Field Book by Captain Oswald Boelcke documenting his wartime letters home. Ace of Aces, by Captain Rene' Fonck was instrumental in capturing Fonck's lengthy wartime experiences. Winged Warfare by Major William A. Bishop was written during a leave period in London prior to his return to combat and continued success. While adequately covering this early period, "Billy Bishop Ace of Aces," Air Force Magazine, by William W. Walker, was necessary for coverage of the later period. Ace with One Eye: The Life and Combats of Major Edward Mannock, Royal Flying Corps and Royal Air Force by Frederick Oughton was perhaps the best of this category for fully accounting an individual's experiences. Fighting the Flying Circus by Captain Eddie Rickenbacker provided useful information of Rickenbacker's war experiences, while Eddie Rickenbacker by Hans C. Adamson provided additional background material. While these readings tend to sometimes over-romanticize World War I air combat, they are validated by the historical record.

The Historical Record

Historical references, while illustrating aces in relationship to a particular theme, assist in defining external factors which may have had an impact on an individual's development or performance in combat. These works additionally help to frame the period by detailing development progression of each external factor. Three works which proved useful by providing detailed data of the individual representational figures' victories were Above the Lines, Above the Trenches and Over the Front by Christopher Shores, Norman Franks, and Russell Guest. Sources, such as Decisive Air Battles of the First World War by Arch Whitehouse and Full Circle by Air Vice Marshal J.E. Johnson, provide information on air warfare strategy and development of air combat philosophies. The U.S. Air Service in World War I, Volume I edited by Maurer Maurer presents information on American pilot training not available in other sources.

External Factor Technical Specifics

Reference material proved helpful by providing extensive information on specialized topics coincident with this study's external factors list. Rise of the Fighter Aircraft 1914-1918 by Richard P. Hallion presents the World War I fighter aircraft in five generational categories. This information analyzed with cognizance of the historical record produces four clear surges in fighter performance capability.

CHAPTER 3

METHODOLOGY

This study uses the historical research method. The research effort focuses upon the accomplishment of three tasks: first, the establishment of a basic external factor framework from which to work; second, an illustration of external factor effects upon the success of World War I aces; and ultimately, the determination of common external or non-personal factors which contributed to the success of the World War I aces.

Chapter 4 provides an examination of World War I external factors and is divided into five sections: background, aircraft, combat environment, opportunity for tactical innovation, and training opportunity. A basic understanding of the external factors is accomplished through analysis of primary and secondary sources. In responding to the study's secondary questions, this analysis focuses directly upon the external factors and is divorced from external factor effects upon the aces. This accomplishes three important tasks. First, it independently documents change and direction within the individual external factor categories; second, it validates each category for continued study; and finally, it facilitates further analysis.

Chapter 5 provides specific external factor conditions for five representational figures. The external factor categories of background, combat environment, aircraft, opportunity for tactical

innovation and training opportunity are provided for Hauptmann Oswald Boelcke, Captain Rene' Fonck, Colonel William Bishop, Major Edward Mannock, and Captain Edward V. Rickenbacker. The chapter is divided into five sections highlighting the aces, with each section further subdivided into the five external factors described. An analysis of primary and secondary sources provides answers to the study's secondary questions inclusive of external factor/ace interface conditions. This research, when balanced with information presented in chapter 4, accomplishes four fundamental tasks. First, it documents conditions within each external factor category affecting the performance of the individual; second, it enables a determination of external factor relevance when measured along the time-change model established in chapter four; third, an assessment of contributions to the success of a specific ace, made by individual external factors, can be established; and finally, it facilitates further analysis.

Chapter 6 documents the common external or non personal factors which contributed to the success of the World War I aces. This conclusion is based on collective analysis of the information presented in chapters 4 and 5 and is presented in six sections: the five external factors and recommendations.

CHAPTER 4

EXAMINATION OF EXTERNAL FACTORS IN WORLD WAR I

Introduction

This chapter presents background material on the development of air combat in World War I and is divided into five sections. The first section contains information relating to the general background of the World War I fighter pilot. The second section contains information regarding the development of fighter aircraft. The third section describes the combat environment that fighter aircraft operated in, the changes over time, and their effects upon the individual combat air services. The fourth section details factors affecting World War I fighter tactics and common tactics employed by the various air services. The final section describes each nation's pilot training efforts.

Background

World War I air combat is routinely characterized by a common, reoccurring theme contrasting the hopelessness of trench warfare to the chivalry of the aces. That this observation is over-romanticized is certain, however, it does present the perception of a class system. It is therefore important to evaluate this perception while primarily identifying and categorizing influences which may have produced the motivation and requisite personal skills of the World War I ace. Specifically, analysis of social and economic conditions, education opportunities and peripheral conditions possibly affecting the aces'

successful development will be conducted. Examples of these peripheral conditions include opportunities for athletic competition and other opportunities influencing the individual's personal development.

Combat Environment

It is important to analyze each ace's combat environment to determine its dynamic or permissive nature. Dynamic combat environments are characterized by varied challenges. These challenges produce responses, such as the evolution of skilled warriors. Permissive combat environments are generally recognized by the stagnancy of a status quo and generally reward combatants who maintain some form of advantage. The distinction between the two are relevant to understanding the success obtained by the World War I aces. Specifically, did the aces blossom as the result of the pressures of a dynamic combat environment, or did they capitalize on an existing superiority within permissive conditions?

The Germans failed to capitalize on the Eindecker's capability and missed an opportunity to gain total air superiority. This period of air combat was permissive in nature because of the infancy of fighter aircraft design, armament, tactics, and strategy. The possession of a flying gun provided the advantage to the Germans. Air combat could be sought by the Eindecker-equipped pilot and defined in his own terms. Had the Germans accomplished three fundamental tasks they could have swept the allies from the skies. First, they needed to mobilize the aircraft industry to produce as many Eindeckers as expeditiously as was possible. Second, introduction of the Fokker should have been withheld until large numbers could have been employed. Finally, they should have then pursued an offensive rather

than defensive strategy with particular attention to a defined campaign to gain air superiority. By the end of October 1915 the Germans possessed 55 Eindeckers and were only able to increase their numbers to 86 by the year's end.¹ The strategy choice of Luftsperr, or air blockade using barrier patrol tactics, put the Germans on the defensive, thereby limiting the offensive potential of the Eindecker. This defensive strategy continued throughout the war.

The Battle of the Somme began on 1 July 1916, and the allies quickly established air superiority. They employed large numbers of aircraft with the single purpose of seeking out and destroying German aircraft over and behind enemy lines. This offensive strategy easily negated the effectiveness of the limited Fokker Eindecker patrols. This was accomplished through the use of newer, comparable aircraft. The air combat environment had become dynamic relative to its previous permissive nature. Whereas independent air operations had been the norm, allied combined air operations now occurred.

The German fighter pilots had plenty of targets because of British insistence on conducting offensive operations. The British continued reconnaissance, artillery spotting, and bombing missions even when the Germans held an aircraft performance advantage. The RFC's casualties continued to mount, and in late 1916 early 1917, a vicious cycle began as newly trained British pilots with as little as seventeen flight hours were thrown against seasoned German pilots.

The causal factors for the RFC failures were threefold: first, the RFC did not possess adequate aircraft for the missions and threat; second, the prevailing westerly wind forced fights deeper into German territory; and finally, the British maintained an aggressive, offensive policy regardless of the losses. During "Bloody April"

1917, the Germans achieved a five-to-one kill ratio, and the RFC lost 151 aircraft, one third of its inventory; 75 of these losses occurred during 4-9 April 1917.² The Germans had organized their finest fighter pilots into Jagdstaffel (squadrons) and then into the Richthofen Jagdgeschwader (fighter wing). These units rarely operated in an offensive manner across the lines, but continued large formation patrols to defend specific sectors. The life expectancy of an RFC pilot was two months. The British loss rate in the air for the entire war was one in four, quite similar to that of the British infantry.³

During April 1918, the Royal Naval Air Service and the Royal Flying Corps were combined into the newly formed Royal Air Force (RAF), and the American First Pursuit Group made its debut. Several of the Americans were experienced in air combat through their service with the French and British. While the advantages of fighting in numbers were known, there were many who still engaged in air combat against superior numbers individually. The recklessness with which some of these pilots fought is described:

On 27 October 1918 Major W.G. Barker, a Canadian with No. 201 squadron, flying a new Sopwith Snipe fighter-had just shot down an enemy two-seater reconnaissance aircraft at 21,000 feet over the Forest of Mormal when he was attacked by a Fokker D.VII and wounded in the thigh. The Snipe went into a spin, and when Barker recovered he found himself in the middle of a formation of fifteen Fokkers. He immediately attacked them, damaging two and shooting down a third before he was wounded again in the other thigh. The Snipe entered a second spin and this time Barker blacked out for a few seconds, regaining consciousness to find himself surrounded by another fifteen Fokkers. He shot down one of them, then a bullet shattered his left elbow and he again lost consciousness. When he recovered he was immediately attacked by fifteen more German fighters; by this time his aircraft was belching smoke, and convinced that it was about to catch fire, Barker dived at the nearest Fokker with the intention of ramming it. At the last instant he changed his mind and opened fire, the German fighter went down in flames. Breaking off the unequal combat, the Canadian managed to get away and eventually crash landed in the Allied lines.⁴

Factors which favored the Germans included favorable prevailing winds and air combat engagement locations. The majority of World War I air combat occurred behind German lines as the result of aggressive British deep operations. Air combat engagements near the lines would additionally drift into German territory as a result of the prevailing winds. Aircraft requiring emergency landings because of engine difficulties or battle damage would most likely land in German territory. German pilots in this situation would be back in the war quite rapidly and afforded the opportunity of continued service.

Aircraft

World War I fighter performance qualities of speed, agility, durability, firepower, service ceiling and climb performance increased at a phenomenal rate. Operational service periods of a year were not uncommon as platforms quickly became obsolete. German and allied fighter production did not follow parallel tracks. This resulted in a cycle of fighter performance advantage and disadvantage between the combatants. Determination of where an ace's air combat experiences occurred during this cycle is important to understanding the conditions in which the individual operated.

At the outbreak of World War I the aircraft, only eleven years' old, entered combat with the nature of its employment defined by its limited existing capabilities. Evolving mission requirements eventually specified the design and function of combat aircraft; and, once the requirement for air superiority was defined, accelerated performance improvements in subsequent aircraft design. The early aircraft, based upon civil aviation design providing for stable platforms, generally had sufficient endurance to provide requisite

reconnaissance time on station. Stability, which was ideal for reconnaissance platforms, came at the cost of limited maneuverability. This lack of maneuverability, combined with the low service ceilings and slow speeds produced by underpowered engines, resulted in platforms of marginal performance.

Richard P. Hallion identifies five generations of World War I fighters.⁵ The continuous change in fighter design, with the resultant obsolescence of earlier designs, is evident in the various types, numbering more than seventy, and their limited operational service period. These periods vary and often overlap introduction dates and service periods of aircraft in adjacent categories.

The first generation fighters were prewar designs which were modified for air combat. These modifications resulted in poor performance capabilities compared to follow on designs. "Most, for example, made use of Wright-derived wing-warping for lateral control rather than the more efficient movable ailerons."⁶ Wing-warping was a rudimentary technique to generate roll by altering the camber of the wing. This design technique produced sluggish roll rates which is not optimum for a fighter. Aircraft in this category include the French Morane and the German Fokker Eindecker.

Second generation World War I fighters consisted of many prewar designs also; however, these were originally designed to carry weapons. Additionally, they were more maneuverable by replacing wing warping techniques with ailerons. Aircraft within this category include the British D.H.2 and the French Nieuport 11. Second generation aircraft did not owe their origins to the Fokker scourge.⁷

Third generation World War I fighters were the first to base their design specifically upon combat lessons learned. Families of

fighters evolved within this generation such as the German Albatros and the French Nieuport 17 through 27.

These aircraft were more powerful...with more efficient armament systems (as exemplified by a trend towards twin synchronized machine guns firing forwards and rotating and traversing ring-type gun mounts for an observer), improved structural design, and great attention to reducing aerodynamic drag and streamlining.⁸

The Germans' respect for the Nieuport 17 aircraft effected the development of three third-generation German fighters; the Siemens-Schuckert D 1, the Albatros D III V strutter, and Albatross D V. The Siemens-Schuckert D 1 was a direct copy of the Nieuport 17, and the Germans copied the Nieuport's wing in the design of the Albatros D-III, V-strutter, and the Albatross D V. The wing-spar-fuselage interface design weakness of the Nieuport which frequently resulted in catastrophic wing failure under heavy maneuvering was thereby passed into these designs. Additional aircraft in this category include the British Sopwith triplane, the French Spad VII, Nieuport 24 and the German Fokker Dr.1 triplane.

Fourth-generation World War I fighters saw service beyond the armistice and set performance standards that carried into the late 1920's and early 1930's-in contrast to earlier fighters which became obsolete within a span of months. These aircraft were very powerful, their strong structures providing rugged platforms while maintaining refined handling and maneuvering characteristics. The structural integrity of the World War I fighters was highly questionable until delivery of the fourth generation fighters. Most aircraft, specifically the Nieuport, sometimes shed their upper wing fabric in high speed dives. Fourth generation World War I fighters had greatly enhanced strength characteristics, such as the S.E.5a's capability of

diving at 275 m.p.h.⁹ The allies produced fourth generation fighters as early as March 1917, while the Germans continued to field third generation fighters as late as April 1918. Fourth generation fighters include the British Bristol Fighter, S.E.5 and Sopwith Camel, the French Spad XIII, and the German Fokker D VII.

Fifth generation World War I fighters were all-metal monoplanes constructed of internally braced, corrugated metal and armed with synchronized twin Spandau machine guns. Two types were built: the German single-seat Junkers D-I, and the two-seat version, the Junkers CL-I, which carried an additional Parabellum machine gun on a swivel for the observer. Only forty-one D-1s and forty-seven CL-I's were built because the Fokker D-VII, already in production, was easier to build. Distribution of these aircraft were in ones and twos amongst the various squadrons.

Four definite surges of fighter superiority occurred in World War I. The development of fixed, forward firing, synchronized machine guns took the form of the German Fokker Eindecker, providing an enormous advantage. Anthony Fokker, a Dutch aircraft designer, developed a synchronized machine gun system which simply fitted a small knob on the propeller which would strike a cam when it revolved. This cam was connected by wire to the machine gun's hammer. The German Parabellum machine gun adapted more easily to the synchronization gear than did the French Hotchkiss, contributing to the success of the Fokker synchronization gear.¹⁰ Simplistic as it may sound, this device was a revolutionary technological development at the time. Fokker demonstrated his single seat, monoplane Eindecker E-1 with its synchronized gun in May 1915. A close copy of the French

Morane aircraft, it proved to be less maneuverable but more lethal as a result of its weapons system.

The second surge, favoring the allies, occurred with allied introduction of the second-generation D.H.2 and Nieuport 11. The first RFC single seat fighter squadron did not enter service in France until February 1916, with the arrival of No.24 Squadron and its D.H.2 pusher biplanes. Lacking a machine gun synchronization gear, the De Havilland company designed the D.H.2 as a fighter using a pusher engine configuration. These second generation aircraft mounted a single .303 Lewis machine gun on a pivot at the port side of the cockpit. The British eventually realized that by fixing the gun forward and aiming the aircraft they had better gunnery success. Just as maneuverable, although slower than the Fokker E-III, it provided the RAF's greatest response to the Fokker threat. The Nieuport 11, referred to as the Bébé, entered service in early 1916 and was armed with a stripped Lewis machine gun mounted on the upper wing that fired over the propeller arc.

The third surge returned aircraft superiority to the Germans with the third generation Albatros D.I and D.III. These plywood covered fighters were stronger, and the twin Spandau machine guns of the D.III gave an enormous firepower advantage over their adversaries.

The allies reclaimed superiority in the fourth and final surge with introduction of fourth-generation aircraft nearly a year ahead of the Germans. In March and April 1917, the Bristol Fighter, S.E.5 and Spad XIII were introduced with the Sopwith Camel following in June 1917. The British Sopwith Camel proved to be the most successful fighter of the war, accounting for the downing of 1,294 enemy aircraft in sixteen months' service.¹¹ Tricky to fly, in the hands of a

skilled pilot it was deadly, and second only to the Fokker Dr.1 Triplane in maneuverability.¹² The Germans were the first to mount twin synchronized machine guns; however, the allies eventually overcame their armament deficiency with the introduction of the Constantinesco hydraulic interrupter mechanism which gave a quicker rate of fire to the twin-gunned Sopwith Camel.¹³ The SE-5's armament included a synchronized Vickers machine gun and a Lewis machine gun mounted on a swivel located on the upper wing.¹⁴ The Spad XIII's armament consisted of two fixed Vickers machine guns. The Spad XII, with which the French ace Rene' Fonck scored eleven of his seventy five kills, had an additional armament of a 37 mm cannon firing through the propeller hub.¹⁵

The Germans did, however, eventually obtain parity, and in some cases an advantage in fighter performance with introduction of their own fourth generation fighters. The third-generation Fokker Dr.1 dreidecker (triplane) entered service on 28 August 1917, and was a copy of the Sopwith Triplane. Its development ensured that the Germans would remain at a third-generation position while the allies were fielding fourth-generation fighters. Although the Fokker dreidecker could out maneuver all aircraft, its excessive drag made it slower than its adversaries and reduced the pilot's capability to disengage from fights at will. On 26 April 1918, the Germans introduced the Fokker D.VII biplane, armed with two fixed Spandau machine guns. It was acclaimed the finest fighter of the war.

Opportunity for Tactical Innovation

It is important to determine the existence of the aces' opportunity for tactical innovation and their response. This will

help to determine whether the representational figures became successful by responding to an opportunity or were simply executing preexisting tactics, albeit quite well. Additionally, given that the aces responded to an opportunity, it is helpful to determine patterns of response. To accomplish this will require three tasks: first, determination of those conditions which influenced air combat tactics development; second, determination of preexisting tactical procedures relative to the individual ace; and finally, analysis of the aces' response to this opportunity. This section addresses general conditions and procedures. Chapter 5 will analyze the individual representational figures relative to this information.

Conditions

Service ceiling, maneuverability, speed, rate of climb and armament had quickly become desirable traits in fighter aircraft design. These changing conditions also presented serious considerations for the World War I fighter pilot in the development of air combat tactics.

Service Ceiling

Air combat in the early stages of World War I most often occurred at 5,000 feet and later at 15,000, although it was not uncommon for aircraft to meet at 20,000 feet and above. Although the Germans used supplemental oxygen in some of their Gotha bombers and airships, none of the combatants routinely used it in their fighters. High altitude was a treacherous place for the open cockpit fighters.

Maneuverability

Turning engagements resulted when fighters maneuvered postmerge for an advantage. The turn radius of the World War I

fighters measured less than one tenth of today's most agile fighters. Manfred von Richthofen, during his fight with British ace Major Lance Hawker "estimated the diameters of the circles at between eighty and one hundred yards"¹⁶ equaling a turn radius of 120 to 150 feet. The gunnery tactic most effectively used was to fly as close to the target as possible and fire well aimed bursts. "Deflection shooting, to become so effective in the Second World War, was attempted by scouts and observers from the early days of the First World War but was not as effective as attack from a blind spot."¹⁷ One can only imagine the close proximity of these biplanes and triplanes, maneuvering for an advantage to employ machine guns from ranges as close as 15 yards.

Max Immelmann is credited with a maneuver in which, following a diving attack, he would climb in a half loop and roll to an upright position at the top. Frank Courtney, a British test pilot and survivor of an early Immelmann attack contended that "the Eindecker's wing-warping method of lateral (roll) control and relatively low power, [made] such a maneuver...quite impossible for Immelmann to perform". The "Immelmann" probably was a climbing turn or chandelle used to regain altitude. Maneuvers similar to this had been demonstrated before the war, however, they may not have been used tactically until Immelmann.¹⁸

Speed

While maneuverability is important to a fighter, so is speed. The World War I fighter with a speed advantage could engage or disengage at will. There are numerous accounts of World War I aircraft overtaken by the enemy and shot down while trying to escape a fight. The German ace Voss, flying the Fokker Triplane, outmaneuvered

his seven British adversaries but did not have the speed required to disengage and was, therefore, killed.

Rate of Climb

The rate that a fighter climbs to a specific altitude translates not only into the aircraft's capability to intercept higher enemy aircraft and regain altitude after a fight, but additionally is an indication of excess power capability of the aircraft. An air combat engagement between two aircraft of similar turning performance, but with different excess power capabilities, would result in one fighter, the one with the excess power advantage, either losing less altitude or retaining the ability to climb or accelerate. During von Richthofen's engagement mentioned earlier, he recognized that his adversary's aircraft "was excellent for maneuvering and speed, but my machine gave me the advantage by being able to climb better and faster. This enabled me at last to break the circle and maneuver into a position behind and above him."¹⁹ It was possible, under certain conditions, for World War I fighters to disengage by simply climbing away.

Armament

The Germans maintained a firepower superiority throughout most of the war. The Fokker Eindecker provided a synchronized machine gun system in the summer of 1915, and the Germans quickly experimented with up to three synchronized machine guns, finally accepting twin Spandau-built Maxim guns as the norm. The allies relied on arrangements of one synchronized Vickers (a modified version of the Maxim) and one upper-wing mounted Lewis machine gun, until delivery of the Spad 13 and the Sopwith Camel in the spring/summer of 1917. The

twin synchronized systems not only doubled the firepower of the fighter, but their accessibility additionally made clearing jams easier. The Lewis machine gun was tricky to reload and clear. The machine gun mount provided by the Cooper-Foster rail on the Nieuport 17C and the S.E.5 enabled the Lewis machine gun to be drawn back from its upper wing location, tilted and reloaded.

Procedures

"We were too busy fighting to worry about the business of clever tactics." said Harold Balfour, British World War I fighter pilot and later British Under-Secretary of State for Air.²² Procedures for coordinated multi-plane air combat and command and control developed as the war progressed, with the Germans taking the lead. The German Eindeckers were employed primarily in single-plane attacks, although they occasionally patrolled and fought in flights of two. The Fokkers would seek altitude and position themselves between the target and the sun for a high speed, preferably unobserved, diving attack. They would make their firing pass and then trade the airspeed they had gained for altitude to reposition themselves for subsequent attacks, if necessary. These tactics were referred to by the allies as the Fokker Bounce and led to the saying "beware of the Hun in the sun". The advantage of height and surprise for relatively high speed slashing attacks with subsequent disengagements was eventually understood by all combatants.²⁰

Attacks against two-seaters armed with a rear firing machine gun were similar, with the exception that the Fokkers would dive through the target's altitude well aft of the observer's effective machine gun range and then conduct a climbing firing pass from below. Not only did this type of attack negate the rearward firing capability

of the two seater but would often position the fighter in the target's blind spot. Additional blind spots existed and were exploited, such as forward and above the adversary using the target's upper wing to mask the attack. The tactical use of the blind spot was quickly incorporated by the allies, and Edward Sims notes: "British ace, Albert Ball, employed and helped make famous the tactic of flying below an adversary and using his gun (then mounted on the upper wing) to shoot up and ahead into his victim."²¹

Formation tactics ranged from the early two-ship cooperative attacks to the large formations flown by Richthofen's Flying Circus. Some individuals on both sides of the lines, however, still conducted lone wolf patrols throughout the war. Command and control difficulties persisted in the absence of radio communication and required use of prearranged visual signals. The Germans were the first to utilize early warning and fighter direction systems. Crude, though effective, they utilized forward anti-aircraft batteries which would direct the Fokkers to the enemy through a system referencing anti-aircraft bursts. Eventually they were additionally able to indicate the altitude, numbers and formation of the allied aircraft to the German fighters.

Although the Germans operated in increasingly larger numbers, their formations were not standardized. Once these formations initially engaged flights of enemy aircraft, the German fighters often conducted individual attacks. British Air Chief Marshal Sir Donald Hardman, who had flown Sopwith Dolphins in 1918 later wrote:

It was a constant source of surprise that Germans never flew in any recognized formation but just exactly like a cluster of flies. I am convinced that if they had adopted our method of formation they would have given us a great deal more trouble... The enemy I saw flew in no sort of a semblance of a formation

apparently without even a leader, and yet frequently I have noticed them all seemingly working to one and the same end without any visible means of understanding each other, and yet they must have been under one brain because no two pilots think and see the same.²³

By mid-1918 RAF wings were organized into Combined Offensive Patrols (COPs) with two to four squadrons conducting raids on German airfields and providing escorts for bombers. A typical COP might consist of Camels at 12,000 feet, SE-5s at 18,000 feet, Dolphins at 21,000 feet and sometimes Bristol Fighters employed to exploit the qualities of the different types. When these formations engaged the enemy large dogfights would often occur, ranging in altitude from 20,000 feet to the ground. Operations against German airfields eventually involved attacks 15-20 miles into enemy territory with a squadron of Snipes at 7-8,000 feet, a squadron of Bristol Fighters at 6,000 feet, a squadron of Camels at 4,000 feet, a squadron of SE-5s at 3,000 feet and DH-9 bombers at 2,000 feet.²⁴

Training Opportunity

It is important to determine the training opportunity afforded the World War I aces to identify this influence upon their success. Specifically recognized are training opportunity factors of availability, quality and focus. The availability of instruction, time and assets and the quality of instruction in terms of what can reasonably have been expected are of obvious relevance. Not as obvious is the identification of training requirements which could have come from two sources: an institution, such as a tactics school, or from the individual himself. An individual's determination of training requirements in response to a training opportunity is of particular interest.

Flight training for the British was haphazard. The RFC did not have a standardized program for training instructors until Robert Smith-Barry established a School of Special Flying at Gosport in late 1916. Many of the early instructors were combat pilots returned from the front for a rest, rather than skilled instructors. The RFC had a frightening training accident rate, with more than 50% of the RFC World War I pilot fatalities occurring during training. By contrast, less than 25% of German pilot fatalities occurred as a result of training accidents.²⁵ By the time the United States entered the war much had been learned by the allies about flight training and its value. U.S. training fatalities averaged 6% for completely trained officers; however, fatalities in U.S. Pursuit training averaged 11%.²⁶

British fighter pilot training suffered from the aggressive strategic offensive and was generally limited to the efforts of individuals. Outclassed in the air technologically and tactically, the British suffered great losses, including many of their experienced pilots. The need for replacement pilots exceeded that which the training process could adequately supply, and training was sacrificed to meet demand at the front. The exception to this lack of British pilot preparedness was Major George Lance Hawker of the RFC. Given command of Number 24 Squadron with its DH.2 pusher fighters, Hawker put the squadron through an extensive five-week training program stressing formation flying and gunnery skills. Upon their February 1916 arrival in France, Number 24 squadron achieved immediate success and ran up an impressive record. Hawker eventually fell in combat to von Richthofen, who heralded his eleventh victim as Britain's Boelcke.

Recognizing its deplorable state of training, the RFC stressed training and operational practice from early 1917 onwards and carefully examined all new pilots before committing them to combat. This period corresponded with the decline in German fighter pilot training following the death of Boelcke on 28 October 1916. Additionally, the British fighters introduced in the spring of 1917 proved superior to the Albatros and provided the allies the initiative.²⁷

Early German squadron-level training programs of detailed preflight briefs, post flight debriefs, and tactics analysis laid the foundation for the air combat success of several German pilots. In this early war period it is noted that "while the experience and operational skill of German fighter pilots rose, the average experience and skill level of RFC pilots declined."²⁸ The Germans were in command of air combat in early 1917 as a result of their training and the superiority of the Albatros fighter.

There were only 65 flying officers in the U.S. Army on 6 April 1917, when the United States declared war. Seriously lacking aircraft, the Americans required assistance from the British, French and Italians for flight training. In all, approximately 2,300 American airmen were sent to Europe, or enlisted while overseas, without preliminary flight training.²⁹

Pursuit, or fighter training, was accomplished at Issoudun, France, and the Americans enjoyed dedicated training unavailable to the allies earlier in the war. After completion of advanced flight training, the student was put through a training syllabus which included acrobatics, formation flying, air combat and occasionally some night flying. Upon completion of pursuit training and before

assignment to combat, the fighter pilot was put through an air-to-air gunnery course. The 'luxury' of these institutional measures was not previously available for the allies.³⁰

CHAPTER 5
INDIVIDUAL ACE PROFILES

Introduction

This chapter presents individual profiles of the representational figures based upon historical research, with focus on the external factor categories of background, combat environment, aircraft, opportunity for tactical innovation and training opportunity. The aces are presented in chronological order of their combat activity to provide an additional perspective of the rapid change in the complexity of air combat as the war progressed. This chapter is presented in five sections: section one-Hauptmann Oswald Boelcke (first victory 4 July 1915, KIA 28 October 1916), section two-Captain Rene' Fonck (first victory 6 August 1916), section three-Major William "Billy" Bishop (first victory 25 March 1917), section four-Major Edward Mannock (first victory 7 June 1917, KIA 26 July 1918), and section five-Captain Edward V. Rickenbacker (first victory 29 April 1918).

<u>Nation</u>	<u>Ace</u>	<u>Victories</u>
Germany	Hauptmann Oswald Boelcke	40
France	Captain Rene' Fonck	75
Canada (RFC)	Major William Bishop	72
Great Britain	Major Edward Mannock	73
United States	Captain Edward Rickenbacker	26

Hauptmann Oswald Boelcke

Background

Oswald Boelcke was influenced by a background which included scholarly interests, athletic activity, and discipline formed through a military education. His father was the senior assistant master at the higher modern school at Halles, and later became a professor at Antoinette school in Dessau, where Oswald, the fourth of six children, was raised. As a child Boelcke's favorite subjects were mathematics, history and physics; he also maintained an interest in machinery. Active in swimming, diving and climbing, Oswald persisted despite an asthmatic tendency as a result of the whooping cough in unfavorable weather. His swimming skills were put to test in August 1915 when he saved the life of a drowning French boy. Although the local French citizens were unsuccessful in getting the French government to recognize this act, Boelcke did receive the German lifesaving medal, which he proudly wore with his many awards. At the age of thirteen Boelcke wrote a letter to Kaiser Wilhelm requesting a palace appointment to the military academy, as his father could not afford the expense. Surprisingly, he received a positive response by the Kaiser but was politely informed that he would first have to finish grammar school. His education eventually continued at the War Academy in Metz where practical instruction in the cavalry section to which he was assigned consisted of gymnastics, drill, riding, and shooting. He was finally admitted to the army on 15 March 1911.

Boelcke entered military aviation at its beginning. After initial training as a wireless officer, he gained acceptance to the Halberstadt Flying School on 2 June 1914. The elementary nature of this flight training is evident in his "Flying Triumphs for July"

report made on 3 July 1914: "Total flying time: 231 minutes=3 hrs, 51 mins. Starts: 30- 8 on a 70 h.p. Taube, 22 on a 100 h.p. Taube, all of which were instructional flights. Maximum height: 1,500 meters. Breakages: None."¹ The training aircraft were so crude that often in certain weather conditions they could only attain 10-15 meters in altitude. He finally passed his pilot's test on 14 July 1914, after a "high altitude" flight which culminated in the attainment of 300 meters after a 15 minute climb. Boelcke managed to complete his flight training with only a damaged propeller received in an early landing incident.

Combat Environment

The combat environment in which Oswald Boelcke fought was one of continuous change and experimentation. While initially experiencing a permissive environment he additionally fought successfully in a dynamic combat environment. The period September 1914-October 1916, during which Boelcke flew in combat, saw the airplane develop from unarmed reconnaissance platforms capable of only 55 m.p.h. to armed fighters specifically designed for air combat and capable of 109 m.p.h and service ceilings of 17,000 feet.²

After the mobilization was ordered on 1 August 1914, Boelcke was assigned to the 4th Base Aviation Park at Trier, where he helped to train pilots and provide replacements to the front. The 13th section, in which his older brother Wilhelm was an observer, was located at La Ferté sur Chiers and needed two replacement aircraft. Boelcke had been personally denied transfer to the front. Under the pretense of delivering an aircraft elsewhere in a park relocation effort, he took off late enough to force him to land, due to darkness, at none other than La Ferté sur Chiers. This scheme paid off because

not only was he accepted into the section, he was immediately assigned as a pilot with his brother Wilhelm as his observer.

Oswald Boelcke acquired combat experience at an accelerated rate, which enhanced his flying skills and combat awareness, while ultimately securing his position as the father of air combat. Oswald Boelcke flew his first combat mission on 1 September 1914, performing artillery reconnaissance from an altitude of 2,800 meters. The brothers, not content with scheduled flight minimums, actively sought additional combat sorties together. Oswald's eagerness for combat was not limited to flying only with his brother, and he was occasionally scolded by Wilhelm for flying around on him. The brothers quickly exceeded their section mates in combat missions flown and presentations of the Iron Cross. By 4 January 1915, Wilhelm had flown 61 flights over enemy territory, Oswald had flown 42 flights, and the remaining section members had individually flown between 20 and 27 flights.³ Oswald was the newest pilot to the section and was unable to affect the command climate. Instead of the brothers' accomplishments bolstering the section's fighting spirit, it served to slowly alienate them and eventually resulted in first Wilhelm's and then Oswald's transfer. Ironically, this transfer was to positively affect the fighting spirit of German pilots in two world wars.

Oswald Boelcke's transfer on 25 April 1915 to section 62 in Douai occurred at the same time that significant changes to German war aviation began to appear. It was not until the cabinet order of 11 March 1915, that the post of Chief of War Aviation was created at which time General von Hoeppner immediately assumed authority over all aircraft and aviation units. No longer under the restrictive direction of the army, the German fighters were able to expand their

missions to meet the increasing requirement for counter air. The air combat environment to this point had been permissive in nature. A stagnancy of neutrality and noneffectiveness existed.

General von Hoeppner clearly recognized the need for an air combat capability, and he oversaw the development of the German fighter with a more powerful 150-hp engine and a machine gun. These C. variant aircraft replaced the defenseless B. variant machines. These aircraft in which the pilot now flew from the front cockpit with an aft observer armed with a pivot able machine gun arrived at Douai coincident with the arrival of Oswald Boelcke.

In May 1915, when the Dutch aircraft designer, Anthony Fokker, delivered the single seat, monoplane, Eindecker-1, he was constantly accompanied by Boelcke. Armed with a machine gun synchronized to fire through the propeller arc, it was arguably the first true fighter. Boelcke continued to fly the Fokker C. when he wasn't flying the Fokker E-1. While flying a Fokker C. aircraft on 4 July 1915, Boelcke scored his first kill, a French Parasol monoplane. This historical accomplishment is considered the "first complete success scored by German airmen in a fight that was deliberately sought and waged according to plan".⁴ The possession of the Eindecker and Boelcke's early demonstration of tactical genius secured an advantage for the Germans within the permissive environment. By 18 Sept 1915, Boelcke had accumulated 76 missions since being with 62 section at Douai, for a total of 118 combat missions.

In June 1916 Boelcke established a Staffel of six aircraft but was grounded on 30 June 1916 by the Chief of Air Service on instructions of the Emperor after the death of Immelman. The air combat environment had become dynamic with the introduction of allied

fighters of comparable capability in a grand offensive strategy. Boelcke could only watch as large formations of the new allied fighters easily defeated the individual efforts of the Fokker defense during the Battle of the Somme in July and August 1916. On 11 August 1916 Boelcke, returned to the Somme to organize and lead Jagdstaffel 2, the creation of the Flying Circus. These Flying Circuses "were intended to be mobile units that could be switched to any sector over which air superiority was needed."⁵ He assembled the most promising pilots he could find which included Manfred von Richthofen and put them through an extensive training period.

The rigorous, incessant training went on for three weeks, during which time Boelcke flatly refused to send his pilots into combat. Boelcke himself flew intensively, adding to his score almost daily, and after every successful mission he would give his eager pilots a lesson in the tactics he had employed.⁶

Jagdstaffel 2 received the Albatros D.1 aircraft and was finally put into battle with Boelcke leading in his black Albatros. Trained and in receipt of the Albatros D.1, Boelcke, on 17 September 1916, led his fighters against a formation of six British FE-2b fighters escorting eight BE-2c bombers, destroying four fighters and two of the bombers without loss. The Jagdstaffel accounted for a majority of the 211 allied aircraft destroyed during September and October, with a total loss of only 39 German aircraft. Boelcke accounted for twenty of these victories during this time.⁷ Although the Albatros was required to counter the capabilities of the allied fighters, it was the tactics development, training, and air combat execution influenced by Boelcke which proved timely.

Boelcke's contributions were critical to the development of the German Air Service fighters, and his impact on the development of

air combat tactics had an immediate effect. "Up to the end of 1915, air combats had been spasmodic, unplanned affairs..., Boelcke realized the importance of carefully planned tactics and concerted action by a number of pilots."⁸ Regarding the impact of Boelcke's leadership and application of his tactical vision, General von Hoepfner wrote;

If then the enemy's superiority in the air that was so oppressive at the beginning of the Battle of the Somme was broken at its end, the merit is due in no slight measure to Boelcke and the Jagdstaffel he led...Eighty seven victories won during the fighting on the Somme testify to their activity...[they] forced the enemy...to adopt a cautious reserve, the effects of which were gratefully noted by the troops on the ground.⁹

Aircraft

The aircraft which Oswald Boelcke flew were generally better if not equal to those of the allies. The Fokker Eindecker was superior to anything the allies had until the arrival of the British D.H.2 and the French Nieuport 17 in the spring of 1916. With these aircraft the allies had achieved parity with the D.H.2 and a superior performance capability with the Nieuport 17. The Fokker E.3 improved upon the E.1 by placing an additional engine in line, increasing the horse power from 80 to 160 while increasing the armament to two and sometimes three machine guns. These additional machine guns resulted in the occasional interrupter gear failure. Boelcke and Max Immelmann each experienced shooting off portions of their propeller on more than one occasion. The two often complained about engine and interrupter gear difficulties and noted that the slightest engine malfunction would make the aircraft extremely unstable, requiring the pilot to abandon his mission, shut down the engines, and glide to landing. Immelmann eventually died on 18 June 1916, after his aircraft

catastrophically came apart as a result of severe engine vibrations, possibly caused by the loss of a portion of his propeller.

Understandably, most of the German pilots actually preferred the Halberstadt or the Albatros D.1 aircraft to the Fokker Eindecker.¹⁰

Boelcke's fortuitous grounding resulted in his absence from air combat at the start of the Battle of the Somme and the upsurge of allied air domination. This shift resulted from the introduction of superior aircraft and was realized by their offensive application. Upon his return Boelcke was equipped with the Albatros D.1., and the majority of his remaining kills were against British aircraft. The Albatros D.1 was clearly superior to the DH2, FE-2b, and Sopwith 1 1/2 strutter, many of which which fell to his guns.

Opportunity for Tactical Innovation

Oswald Boelcke seized the opportunity for tactical innovation, and the tactics which he employed were his own, self-developed air combat tactics. Operating in a period devoid of air doctrine or established tactical procedures, Boelcke's opportunity was ripe. He pioneered the expansion of fighting formations and tactics training, while many aces of this period were content with individual success. While assigned to 62 section Boelcke recognized the vulnerability of the single seat fighter to an unobserved attack and, with Max Immelmann, worked out a system with which they flew and fought together. The resulting creation of the fighting pair, complete with visual signals and lookout responsibilities, laid the foundation for tactics still in use today. During a wartime period of individual pilot actions and randomness of purpose Boelcke specified air combat tactics and doctrine in his Dictums:

1. Try to secure advantages before attacking. If possible, keep the sun behind you.
2. Always carry through an attack when you have started it.
3. Fire only at close range and only when your opponent is properly in your sights.
4. Always keep your eye on your opponent, and never let yourself be deceived by ruses.
5. In any form of attack it is essential to assail your opponent from behind.
6. If your opponent dives on you, do not try to evade his onslaught, but fly to meet it.
7. When over the enemy's lines never forget your own line of retreat.
8. For the Staffel: Attack on principle in groups of four or six. When the fight breaks up into a series of single combats, take care that several do not go for one opponent.¹¹

This last note would prove prophetic on 28 October 1916, when Boelcke was killed in a midair collision with his wingman and friend, Erwin Bohme, resulting from their simultaneous attack upon a single opponent.

Training Opportunity

Oswald Boelcke had developed "from a master of aerial single combat into a masterful instructor of organized teamwork in scout flying."¹² He accomplished this during a period devoid of available quality instruction and institutionally formulated tactical doctrine. What he did possess was time, assets and a sharp intellect. The forcefulness of his convictions regarding training and air combat tactics is evident in a letter to his parents dated 8 October 1916

I have to give my pilots some training. That is not so simple because they are all inspired with such fiery zeal that it is often difficult to put the brake on them. They have certainly all learnt that the main thing is to get the enemy in your power and beat him down at once instead of arguing with him. But until I get it into their heads that everything depends on sticking together through thick and thin when the Staffel goes into battle and that it does not matter who actually scores the victory as long as the Staffel wins it...I always give them some instruction before we take off and deal out severe criticism after every flight and especially after every fight.¹³

Tactician, leader, and teacher, Boelcke simplified the art of aerial gunnery in describing his technique: "I fly close to my man, aim well and then of course he falls down."¹⁴ Boelcke encapsulated essential learning points in his writings "Experiences of Air Fighting", which summarizes tactical considerations based upon his analysis of the strengths and weaknesses of enemy aircraft.

Vickers Single-seater: Very agile, somewhat slower than the Albatros, generally loses height in steep turns. Generally armed with only one machine gun, pivot able in an upward direction (can also fire obliquely upward), but sometimes with two parallel guns. Defenseless in the rear, where the pilots view is obstructed. Best attacked from behind; can also be very effectively attacked from behind and below by means of a zoom.

Nieuport Single-seater: Very fast and agile. Armament and shooting possibilities very similar to our own scouts. Generally loses height in prolonged turning action. Attack from behind if possible and at close range.¹⁵

Joseph Jacobs, the fifth-ranking ace of the German Air Service in World War I with forty eight victories said: "Boelcke was probably the best. He taught us much and Richthofen learned from him."¹⁶

Captain Rene' Fonck

Background

Born on 27 March 1894, in Saulcy-sur-Meurthe, France, Rene' Fonck was keenly aware of the loss of French national honor resulting from their defeat in the Franco-Prussian War of 1870, when he answered the mobilization call on 22 August 1914. Fonck was characterized as being "a cold, aloof man, more admired than liked by his men."¹⁷

Fonck began pilot training on 15 February 1915, flying 45-hp and 60-hp Caudrons, and upon completion, was initially assigned to the C.47 squadron in the area of Corcieux flying the Caudron GIII, a

lumbering aircraft used for reconnaissance and artillery spotting. With an 80-hp engine the Caudron GIII's maximum speed was 70 m.p.h. at sea level, and its service ceiling was 10,000 feet.¹⁸

France had experimented with aircraft armament before the war, whereas the Germans had not. This foresight proved itself when, during the Winter Battle of the Champagne, Germans flying unarmed reconnaissance aircraft faced French 'avions de chasse' flying armed Nieuport and Morane-Saulnier Parasol scouts. This, however, was not the case with Fonck at this time, and on an early mission he passed close aboard a German aircraft, unarmed, without consequence. This made a lasting impression upon Fonck, and he began to carry a carbine with him which, on occasion, he used with moderate success.

Combat Environment

The combat environment in which Rene' Fonck fought was dynamic in nature due to an offensive strategy against a well trained, experienced enemy. His involvement covered the period from February 1915 to the armistice. The first two years were spent conducting operations other than air superiority, specifically reconnaissance and artillery spotting. Fonck's arrival at the front in April 1915 coincided exactly with Oswald Boelcke's transfer from reconnaissance duties to Section 62, and the resultant development of German air combat tactics. Bomb delivery and aerial photography were added to his mission profiles of reconnaissance and artillery spotting around the time that Fonck first encountered the Fokker. During the month of October 1915, flying a twin engined Caudron G IV, Fonck flew thirteen long-range reconnaissance and twenty-four artillery spotting missions, and fought six unsuccessful air engagements.¹⁹ This level of activity was characteristic of Fonck's involvement. During the Somme Offensive

Fonck averaged one sortie per day conducting photo reconnaissance and artillery range adjusting.

On 1 March 1916, Fonck brought down his first unconfirmed enemy aircraft, attributing his previous lack of success to the machine gun types and unstable mounts used on the Caudron. Finally, after two years of flying, he achieved his first official victory on 6 August 1916. On 17 March 1917, while on a reconnaissance mission fifteen kilometers inside German lines, Fonck and another Caudron were attacked by a flight of five German Albatros aircraft. In the ensuing engagement Fonck, through a series of defensive air combat acrobatics, was not hit. However, the other French aircraft was and, in its evasion, was chased by three of the Albatroses. Fonck quickly disengaged from his own fight and shot down one of the Albatroses pursuing the damaged Caudron for his second confirmed victory.

Having thereby distinguished himself in air combat Rene' Fonck, on 25 April 1917, was finally assigned to the 103rd Squadron, 12th combat group, the "Cigognes" or "Storks". The Storks had already accounted for 1,000 German aircraft by this time in the war and were considered the elite of the French fighters. Fonck's victories quickly mounted and, on 11 May 1917, he scored his fifth victory, thus becoming an ace. On 12 June 1917, Fonck engaged a flight of two Albatroses from an up-sun, astern position and observed them conducting a coordinated, defensive maneuver. One fighter turned back hard into Fonck as the other extended for a positional advantage. Maneuvering aggressively to avoid being bracketed, Fonck killed the first German with a burst from an abeam position and then pursued the other fighter who had then decided to disengage. Overtaking the Albatros, Fonck quickly shot him down as well. Documents found at one

of the crash sites identified the victim as twelve-victory German ace Captain Von Baer.

Rene' Fonck's first official victory resulted from the formulation of a deliberate tactical plan. While conducting photo reconnaissance in the vicinity of Roye, Fonck was jumped by two Fokkers which, interestingly enough, disengaged at the first pass with one of the Fokkers, possibly damaged, diving for his own lines. Continuing on with his reconnaissance, Fonck spotted a pair of German two-seat reconnaissance aircraft and quickly formulated a plan. With his inferior aircraft he dove on the Rumplers, intent on attacking the first aircraft to panic. The closest Rumpier panicked, and leaving his wingman behind, dove with Fonck in hot pursuit. After a twenty minute chase the Rumpier finally landed, and its German occupants surrendered uninjured.

About the time that Fonck and the Storks moved their operations to Flanders, during July 1917, they observed a further change in enemy tactics. Large formations of German fighters were engaging the lone French patrols in coordinated attacks at all altitudes and from all directions. By attacking in this manner with eight to ten Fokkers the Germans affected great losses upon the French aces. Eventually the French attempted to adopt similar tactics. Fonck, after initially trying to maneuver six or seven aircraft, employed a triangular formation of three to four aircraft with wingmen responsible for protecting him from attacks from the rear.²⁰

It was during the Flanders offensive of July 1917 that Fonck developed as a superb marksman. Large formations of English, French and Belgian aircraft participated in joint air activities for which Fonck found himself providing fighter cover. Confident and with a

keen eye, he proved himself lethal from every angle, regardless of positioning relative to his target. He stated that "I always utilize the blind spots, and because of that, am forced to fire from whatever position my Spad might be in." This served him well because "by 3 April 1918 he had shot down 32 aircraft, engaged in upward of 200 combats, flown 1,000 hours above enemy lines, yet had never received a bullet hole in his aeroplane."²¹ On 9 August, 1917 a large dogfight ensued with two groups of sixteen Fokkers each. Fonck destroyed one Fokker with a well aimed premerge shot and, after aggressive maneuvering, destroyed a second.²²

On 9 May 1918, over Soissons, Fonck shot down three German two-seaters in a fight lasting only forty five seconds with the wreckage of the three landing within 400 meters of each other. That evening he spotted a German observation aircraft just beyond a layer of clouds. After emerging from the cloud, within thirty meters of the enemy, Fonck quickly shot the aircraft down and only then noticed nine German single seat aircraft, four Fokkers stepped up above a flight of five Albatros scouts. Separated from his own wingman, Fonck found himself one versus nine but remained undaunted as he personally preferred fighting alone. With an altitude advantage he dove at high speed upon the last Fokker and quickly shot it down. As the Germans reacted to this attack, through a series of turns, he closed upon the Albatros patrol leader, shot him down for his sixth victory that day, and with an airspeed advantage quickly outdistanced his pursuers.²³ Rene' Fonck accomplished this sextuple victory with an average expenditure of ten rounds per aircraft.²⁴

Rene' Fonck died in Paris on 18 June 1953. His decorations included the Croix de Guerre with twenty eight palms, the British

Military Cross and Bar, the Belgian Croix de Guerre, the British Military Medal, and the Cross of the Legion of Honor.²⁵

Aircraft

As a fighter pilot Fonck enjoyed aircraft performance parity, if not superiority, over his adversaries. He had remarkably survived the earlier Eindecker and Albatros periods of dominance through spirited defensive maneuvering. This had been done while conducting missions other than dedicated air combat in an aircraft employed for reconnaissance duties.

The Caudron G IV, a twin engine version of the G III in which Fonck saw extensive combat, was armed with one machine gun, had a maximum speed of 82 m.p.h., and a service ceiling of 14,000 feet.²⁶ In comparison, the Fokker Eindecker-1 monoplane with its 80-hp engine was capable of a maximum speed of 82 m.p.h. and had a service ceiling of 10,000 feet. Improvements to the Fokker Eindecker design eventually exceeded the maximum speed of the Caudron but not its service ceiling. Nevertheless, Fonck's superb flying skills were evidenced by his survival of numerous air combat engagements against the specially equipped Fokker while flying the Caudron.

Fonck's assignment as a fighter pilot coincided with allied introduction of fourth generation aircraft, although he initially flew the third generation Spad VII. The Spad VII, although outgunned by the Albatros, had a maximum speed advantage. The fourth generation Spad XIII clearly outclassed anything the Germans could put into the air until the later introduction of German fourth generation fighters. Fonck achieved the majority of kills in the Spad XIII.

Opportunity for Tactical Innovation

Rene Fonck was extremely successful tactically. However, he failed to grasp the opportunity for tactical innovation above the individual level. The French operated extensively as independent aircraft. The opportunity for tactical innovation in developing formation tactics within the Storks existed throughout Fonck's service. Fonck, however, confined whatever innovative tactical thought process he may have had to the matter of his own personal air combat. When tasked to employ a formation of French fighters he simply performed his preestablished attacks with his wingmen arrayed to offer him protection.

Fonck's tactics were simple enough. He chose to attack with an altitude advantage in a high speed firing pass which he likened to the attack of a bird of prey. When attacking a two-seat aircraft with an armed observer he would consciously perform gun jinks until just prior to his own firing. "Fonck was calm and calculating, he brought his own brand of science to air fighting, and it helped him to survive the war."²⁷ One can only speculate upon French air combat results had Fonck applied his talents to the development of French fighter formations and cooperative air combat tactics.

Training Opportunity

Training for the French was largely an individual matter with tactics discussed loosely in the officers mess. After his transition from reconnaissance to fighter aircraft, Fonck became, like many of the French aces, a fighter pilot "who concentrated on running up large scores of victories, but [was a] careful tactician, and excellent marksman."²⁸ Fonck however, left nothing to chance when it came to understanding and countering the threat. "He became a student of air

fighting and spent hours studying the tactics of his opponents, and working out in detail successful plans for attack in all conceivable combinations of circumstances."²⁹ The strictness of Fonck's personal training is evident in his statement

One must be in constant training, always fit, always sure of oneself, alcohol becomes an enemy, all abuses must be avoided. It is indispensable that one goes to a combat without fatigue, without any disquietude, either physical or moral. It is necessary to train as severely for air combats as for any other athletic contest, so difficult is the prize of victory. Yet if one finds oneself in prime condition, all the rest is play.³⁰

Fonck's aerial gunnery ability is considered legendary. He shot down a German reconnaissance aircraft with only five rounds on 27 June 1918.³¹ On 14 August 1918, Fonck attacked a flight of three German aircraft, destroying all three in under ten seconds. The wreckage of these aircraft fell less than 100 meters apart.³² On 26 September, Fonck repeated his sextuple during a full day's fighting, and he survived the war with his official and unofficial victories totaling 127.

Major William "Billy" Bishop

Background

Billy Bishop was born 8 February 1894, at Owen Sound, Canada. At seventeen his parents sent him to the Royal Military Academy at Kingston where, they thought, he would benefit from the discipline. In June 1915 his cavalry unit, the 7th Canadian Mounted Rifles, was ordered to England and, shortly thereafter, he was transferred to the RFC, later stating that; "It was the mud, I think, that made me take to flying."³³ After receiving training as an observer Bishop proceeded to France in 1916. Remarkably, Bishop never engaged in air

combat as an observer during his first four months of combat. At that time he injured a knee in a crash landing and was rendered unable to fly for several months. Upon his recovery he was informed that he would be returning to England for pilot training. Bishop completed his pilot training without incident but was keenly aware of an ambulance, with engine running, observing his first solo takeoff.

After receiving his wings as a pilot, he received further training in operating at night and was retained in England as a balloon hunter to counter the Zeppelin threat. After several frustrating months, Bishop was finally transferred to the 60th Fighter Squadron at the front and arrived at Boulogne on 7 March 1917.

Combat Environment

Bishop's air combat environment was dynamic in nature as a result of continuous offensive operations against a well-trained and experienced enemy. Upon his arrival to the front he was introduced to the Nieuport Scout aircraft and, after four days of training, was considered familiar enough with the aircraft to begin patrolling at the tail end of a six plane formation. Bishop's knee injury, assignment to pilot training and subsequent assignment in England were quite fortuitous. His arrival in France coincided with the air combat domination of the German Albatros, resulting in the Bloody April of 1917. Flight experience gained as an observer and then as a pilot over England certainly placed him above his contemporaries during this period of poor allied training and high casualties.

The opportunity for air combat was ripe if an individual could only survive the Albatros onslaught. On 25 March 1917 as a member of a four plane formation, Bishop had his first encounter with enemy fighters.

Like nearly all other pilots who come face to face with the [enemy] in the air for the first time, I could hardly realize that these were real live, hostile machines. I was fascinated by them and wanted to circle about and have a good look at them.³⁴

The British flight leader displayed an unusual tactic by permitting three German Albatroses to maneuver to within 400 yards of the Nieuports' six o'clock position before adding power and turning to engage. Like Bishop, one of the other Nieuport pilots was also inexperienced, and the two were later in their reaction than their flight leads. In his turn back into the enemy he saw an Albatros executing an unobserved attack on a Nieuport and Bishop quickly maneuvered to the attacking Albatros's blind zone. After scoring hits on the enemy aircraft Bishop observed the German roll over and enter an inverted spin. Suspecting a common ruse he followed the Germans path and was rewarded when the Albatros pulled out of its spin with Bishop in firing position at a distance of forty yards. Bishop's next burst hit the German's cockpit before the Albatros entered another spin. Still not convinced that the German was truly defeated, Bishop followed. After observing, from an altitude of 1,500 feet, the ground impact of his first victory, he realized that he was alone, over enemy territory, uncertain of his location, with a dead engine. Unable to restart his engine, which had oiled over during his high speed dive, Bishop attempted to extend his glide while taking machine gun fire from below and eventually managed to clear the German lines by 150 yards.³⁵

The combat environment was such that even, though new to the squadron, Bishop was rewarded with designation as a patrol leader upon his return to the squadron. Leading a six-plane patrol Bishop observed a single German aircraft operating between an area of patchy

clouds and immediately dove into an awaiting aerial ambush in which the British fighters were engaged by ten aircraft. Once committed he operated independently. Only after escaping from an individual engagement with three German fighters did Bishop manage to reclaim his three separated wingman after losing two early in the fighting to the enemy. His next patrol, with his four remaining aircraft, provided escort for six British photo-reconnaissance aircraft. Flying a thousand feet above the reconnaissance aircraft, he observed a flight of six German fighters climbing to intercept them and an additional two enemy fighters positioning themselves for attack from above. In the resulting melee Bishop achieved his second victory, but in the process, one of the reconnaissance aircraft was shot down as well.

Formation tactics varied according to mission, and Bishop quite often fought by himself. During April 1917 Bishop's squadron was given the mission of "clearing the air" in preparation for the British attacks at Arras and Vimy on 7 April. Operating single ship, Bishop had the mission of destroying a specific German observation balloon. After locating the balloon he was immediately attacked by a German fighter whose mission was to protect the balloon. Bishop quickly neutralized the defensive position he found himself in, obtained an offensive position, and rapidly shot down the German fighter while the balloon was being pulled to the ground. Bishop disregarded the higher headquarters order establishing a 1,000 foot minimum altitude and entered a steep, high speed dive shooting at the balloon from 500 to 50 feet altitude. With the balloon burning he then strafed the balloon crew and the attendant anti-aircraft position. Once again he had reached 200 m.p.h. with his dive in the

fragile Nieuport and similarly killed his engine. While preparing to crash his aircraft into a tree, to render it useless to the enemy, his engine restarted, and he was able to complete his egress. For this action he was awarded the Military Cross.³⁶

Bishop's independent nature was evident the next day, on 8 April 1917, just one day before the British ground offensive, when he launched on an offensive patrol of six aircraft led by their commanding officer. Upon spotting a German two-seater, the commanding officer and Bishop attacked. After verifying his flight lead's kill Bishop pulled out of his dive to find himself, once again, alone. Eventually he spotted a couple of Nieuports and in the process of flying to their position was jumped by an enemy fighter. After an uneventful fight, in which this German escaped, Bishop located an enemy observation balloon and attacked it. However, it failed to ignite. While trying to climb out he was once again jumped by a German fighter and, from a defensive start with jammed guns, Bishop cleared and eventually won out. After observing his latest victim crash, Bishop again started his climb out and spotted a flight of five Germans with the three higher aircraft acting as escorts. Attacking from below was generally avoided. However, Bishop formulated a game plan and attacked the closer of the lower two aircraft. Almost immediately he had to defend against the other German as his initial target elected to expeditiously return home. Bishop was again able to employ the Nieuport's maneuverability to neutralize the German's attack and destroy the enemy with his first burst. Turning to meet the three higher fighters which were already shooting at him, he fired a premerge burst which sent one of the fighters home, and Bishop found himself one-versus-two. At about the time that Billy Bishop ran out

of bullets the two German fighters disengaged on their own. After turning in his report, Bishop's colonel ordered him to take the rest of the afternoon off. This mission earned him the Distinguished Service Order.³⁷ By April it was apparent to Bishop that the Germans were fighting with their best pilots who were engaging only if they had a three-to-one advantage. These were the pilots of von Richthofen's squadron and were identifiable by their brightly colored Albatroses.

In his first five months of combat Bishop had engaged in 110 fights for 47 confirmed and 23 unconfirmed victories. Bishop returned to England in August 1917 and, upon his return to combat in May 1918, assumed the responsibility of commanding the 85th squadron flying the S.E.5 aircraft. Bishop impatiently fought at an extreme pace noting that "My list of victories was not climbing as steadily as I wished...so I went over the lines six or seven hours a day, praying for some easy victim to appear."³⁸ He was credited with the destruction of 25 aircraft in twelve days with twelve of these victories obtained during a three day period. In total, Bishop engaged in over 200 fights, 75% of which were fought independently against superior numbers, while 90% of his flights were over enemy territory.³⁹

Aircraft

Bishop enjoyed an aircraft performance parity if not superiority over his adversaries. Although he arrived at the front when the allied fourth generation aircraft were making their debut, Bishop flew for four months in the third generation Nieuport. The Albatros D.III dominance over its third generation rivals was not evident when the Nieuport was flown by Bishop. He is credited with

the destruction of twenty three Albatros D.III aircraft while flying the Nieuport. Bishop remarked that the Nieuport "had an extremely lethal look about her, as if she were the mistress of some nabob of the Quai d'Orsay on her way to shoot her lover."⁴⁰ When Bishop received the S.E.5 in July of 1917, the Germans did not possess anything of comparable performance. Both the Nieuport and the S.E.5 employed a unique weapons system mounting a Lewis machine gun on a sliding attachment located on the upper wing. Bishop routinely used this flexibility to fire from below into an enemy aircraft.

Opportunity for Tactical Innovation

The opportunity for tactical innovation certainly existed. The absence of institutional doctrine and influences required individual creativity. Similar to the French, Bishop contained his tactical development efforts to a primarily personal effort. This tactical innovation consisted of the prioritization of air combat into three areas: first, aerial gunnery; second, tactics utilized in the attack; and finally, flying ability. In his early air combat engagements, Bishop would fire from 150 to 50 yards, but he eventually determined that if he were to be successful he would have to devote dedicated personal training to gunnery. Eventually he trained himself to hold his fire until he was as close as fifteen yards before firing a short burst of three to fifteen rounds. Bishop preferred to fly alone, over German lines, and after securing an unobserved entry, would dive into formations of enemy aircraft, maximizing the effectiveness of slashing attacks and use of the enemy's blind zones. While stressing the importance of gunnery mastery, Bishop recognized and emphasized flying ability, specifically acrobatics, which gave a pilot confidence in his aircraft and in his own capabilities.⁴¹

Like many of the successful pilots, Bishop flew extensively, often as much as seven and a half hours in a day. While this pace affected other aces over an extended period of time, Bishop claimed that: "Far from affecting my nerves, the more I flew the more I wanted to fly, the better I seemed to feel and each combat became more and more enjoyable."⁴²

Bishop took an offensive approach to even the most defensive of situations: "Every time your opponent attempts to dive at you or attack you in any way, the best thing to do is to turn on him, pull the nose of your machine up, and fire."⁴³ Cognizant of his vulnerability in the attack, especially when operating independently, he noted that: "It is well if you are against odds never to stay long after one machine."⁴⁴

Training Opportunity

Bishop's training was extremely rudimentary, although he did benefit from flight experience gained during his four months as an observer, and later, his several months defending England. Specialized air combat training was not available; however, Bishop's flight experience gave him an edge which he expanded with a personal study of aerial gunnery. With his quick advancement to leadership positions, Bishop was afforded the opportunity to institute relevant air combat training. His failure to do so while adding to his list of victories is similar to that of the French Air Service.

Major Edward Mannock

Background

Edward Mannock was born on 21 May 1888, in a British military barracks, the son of a corporal in the Second Inniskilling Dragoons.

At the age of ten Mannoock suffered an eye affliction which rendered his left eye sightless. While living in India Edward took up reading and playing the violin as his father fought in the Boer War. Edward's schooling found him strong in English and literature but weak in math. His father abandoned the family, leaving them in poverty, and married bigamously when Edward was twelve years old. At the age of thirteen, Edward left school and went to work to help support his family. During these early years Mannoock maintained a passion for cricket and played when it was financially feasible.

In February 1914 Mannoock arrived in Constantinople, Turkey with the goal of becoming a successful engineer, tea planter or rancher. Nearly out of funds upon arrival he quickly secured a job with the English Telephone Company laying cable. In November 1914, Mannoock was arrested by the Turks and put into a prison camp after Great Britain and France declared war upon the Ottoman Empire. After enduring tortuous conditions he was eventually released as an exchange prisoner to England in April 1915. This release resulted from the determination that he provided no military service value due to his astigmatic left eye and poor physical condition resulting from malaria.

Upon return to England he rejoined the Medical Corps until he managed a transfer to the Royal engineers. Having developed a genuine hatred of and deep desire to kill Germans, Mannoock found it unthinkable to possibly have to attend to their wounds. Eventually, following the advice of an old friend and spurred on by newspaper accounts of British ace Albert Ball, he secured an appointment to the RFC. While awaiting his physical examination Mannoock studied available aviation magazines for mention of air combat tactics.

Remarkably, Mannock managed to pass a flight physical eye examination by memorizing the eye chart and was commissioned on 1 April 1916. Edward Mannock began his flying career at the age of 29 when, in contrast, Albert Ball was ending his at 19.

Upon completion of the school of military aeronautics he attended training at Hendon where he passed with honors. Recognizing that his training suffered from an acute aircraft shortage, Mannock borrowed a Caudron aircraft for a solo flight. A short period of grounding followed; however, Mannock eventually received his Aero Club's proficiency certificate on 28 November 1916. Subsequent training included the Hythe Gunnery school.

Combat Environment

The air combat environment in which Edward Mannock fought was dynamic in nature, resulting from continuous offensive operations against a well trained and experienced enemy. Mannock's combat experiences covered the period of 6 April 1917, to his death in action on 26 July 1918. His entry into the war corresponded almost to the month of Billy Bishop's arrival and Rene' Fonck's assignment to the Storks. Mannock arrived at No. 40 squadron during "bloody April" 1917 and, not content with his level of preparedness, immediately pursued an individual training program in the squadron's Nieuport 17. His training followed his personal conviction that air fighting was a science. He spent weeks doing more training than fighting and finally shot down an observation balloon, his first victory, on 7 May 1917. A month later he scored his second victory over a German two-seater and then took leave. Mannock's slow start and aptitude for training rather than combat made him vulnerable to questioning amongst his peers. Mannock's response to this criticism during an interview with

his commanding officer was that "I've been studying it and have not been unduly worried at not getting Huns at the expense of being reckless. I want to master the tactics."⁴⁵

Upon his return to combat, however, in July 1917, Mannock began to accumulate victories rapidly and crossed the lines one to three times a day. He proved to be a skilled tactician and "epitomized the offensive use of the aircraft...starting traditions that extended to the RAF in the Second World War."⁴⁶ Mannock routinely faced skilled opposition and on one occasion fought a purple aircraft, probable the German ace Voss, to a draw.

The allies were forbidden the use of incendiary bullets for air combat, even though the Germans used them. The vision of burning to death in a crippled aircraft haunted Mannock, and he resigned himself to its inevitability. In conversations with his closest friends he would question them on their reactions to such an event and then confess his possession of a handgun for such an eventuality.⁴⁷

Mannock filled key leadership positions, commanding flights in No. 40 and No. 74 squadrons and later as commander No. 85 squadron, where he relieved ace Billy Bishop, who had been called to Canada to organize a Canadian Air Force. Bishop seldom led a squadron patrol, preferring to operate independently. Mannock quickly changed all of that, and his squadron obtained ninety victories under his tutelage, while suffering only two casualties. Forty-victory ace Ira Jones spoke of Mannock's leadership: "He was a forceful, eloquent speaker, with the gift of compelling attention. After listening to him for a few minutes, the poorest, most inoffensive pilot was convinced that he could knock hell out of Richthofen or any other Hun."⁴⁸ His

understanding of the significance of altitude is evident in his golden rule; "always above, seldom on the same level, never underneath."⁴⁹

Aircraft

Edward Mannock enjoyed near parity if not superiority over his adversaries in aircraft performance qualities. Mannock arrived at the front at the same time that the allies fielded their fourth generation fighters, although he initially flew the third generation Nieuport. Five of his first fifteen confirmed kills were over the presumably superior Albatros D.III and D.V. After receiving the S.E.5 in early 1918, Mannock established its superiority over the German fighters. The majority of his credited victories were over German fighters and included five of the venerable Fokker D. VII.

Opportunity for Tactical Innovation

Edward Mannock seized the opportunity for tactical innovation through keen observation, patience and cautious experimentation. Ridiculed for an early apparent lack of aggressiveness, Mannock was instead laying the foundation for successful squadron operations. Mannock's tactics were detailed, leaving nothing to chance. He would often stalk his opponents for an hour or more to orchestrate the ensuing air battle. His keen perception of enemy capabilities and limitations are evident in his writings:

Enemy scouts are not often seen above 15,000 feet during the winter months, the reason being, I suggest, that the Albatros Scout, which constitutes the bulk of enemy scouts, is a very cold machine in comparison with the S.E.5, so that enemy pilots do not go up high during the cold weather, unless for some good reason; therefore, I usually take my patrol over the lines at anything over 14,000 feet. Nine times out of ten I am above enemy scouts during the whole of my patrol.⁵⁰

Mannock believed in attacking as a formation after having fully assessed the situation and then fighting with aggressiveness and tactical soundness. In this regard he was much like Boelcke, knowledgeable in the benefits of aircraft working together:

I find that as soon as we attack scouts, one of them, more likely than not their leader, flies off out of the fight and climbs his utmost until he is above the top S.E., and then he comes back, and it is just the thought that there is a Hun above you that divides your attention and nullifies your advantage in height; so as soon as I see the one Hun going off I climb as well, and this usually frustrates his intentions.⁵¹

An adequate pilot in the air with a record of rough landings, Mannock was a superb marksman and remarked that: "Good flying never killed [an enemy] yet."⁵² The tenacity with which he pressed home his attacks is reflected in his concern that:

One should be very alert when firing at an [enemy aircraft] at close range, so that when [the enemy aircraft] falls to pieces, as they often do after being fired at a lot, that one does not fly through the wreckage. I narrowly missed flying through a pair of [enemy aircraft's] wing's recently.⁵³

Training Opportunity

Edward Mannock maximized his training opportunities and eagerly expanded existing training as his influence grew. Even before his assignment to combat Mannock demonstrated a keen perception of aircraft performance analysis and personal training. While assigned to No. 10 Reserve Squadron at Joyce Green he was afforded instruction on spins and general aerobatics by the British ace J. B. McCudden. Concluding that a spin in a D.H.2 could be performed 500 feet below McCudden's briefed 2,000 feet. Mannock's experiment, within view from his airfield, was made even more colorful by spinning over a TNT factory. After successfully maneuvering out of the spin and landing

within ten feet of a TNT shed, he spent a period of time fighting to maintain his flying status.

An exceptional leader, Mannock conducted thorough briefs and debriefs-stressing formation, aggressiveness and tactical judgment. Continually training his flight members, he often set up victories for new pilots. With a wingman in close formation he would attack enemy two-seaters quickly, killing the observer and severely damaging the aircraft. Often the first the wingmen knew of the enemy's presence was when the target suddenly appeared in front of them belching smoke as Mannock pitched away. They would fire their single burst and be credited with a confirmed victory. It was after one such engagement on 26 July 1918, that Mannock was killed. Mannock attacked a German two-seater and, after a short burst with his machine guns, made way for Second Lieutenant D.C. Ingis, a new pilot, to obtain his first victory. After completion of the kill, while returning to their lines at the unusually low altitude of 200 feet with Ingis in trail, Mannock's S.E.5 was hit by anti-aircraft fire, piercing the fuel tank and igniting the aircraft. On fire and out of control, Great Britain's leading ace died.⁵⁴ Credited with 73 confirmed victories, Major Edward C. Mannock was awarded the Victoria Cross posthumously.⁵⁵

Captain Edward V. Rickenbacker

Background

Edward Rickenbacker was born in Columbus, Ohio on 8 October 1890. At the age of twelve, his father died, and he left school to work and help support his family. He initially worked twelve-hour days, six days a week at the Federal Glass Company and had subsequent jobs in a foundry, a shoe factory, and finally, in a garage. Rickenbacker pursued an education by taking an engineering course with

the International Correspondence school. In 1908 he tested automobiles for the Frayer-Miller company and began auto racing, which included three Indianapolis 500 appearances. He performed well enough as a driver to earn \$40,000 a year by 1917.

When America entered the war, Rickenbacker accompanied General Pershing as his personal chauffeur and, during a chance meeting with Colonel Billy Mitchell, was offered the opportunity to join the Aviation Service. At age twenty-seven he was sent to flight training, and his solo flight followed five and one-half hours of instruction. Upon completion of flight training, Rickenbacker was assigned to the Issoudun training center in France as the chief engineering officer, which gave him the opportunity to log time in various types of aircraft. Rickenbacker was eventually sent to the Air Gunnery School at Cazeau for advanced combat training, which took several weeks. During this time he concluded that "I can see that aerial warfare is nothing more than scientific murder".⁵⁶

Combat Environment

The air combat environment in which Rickenbacker fought was dynamic in nature due to continuous offensive action against a well-trained, experienced enemy. He joined the 94th Pursuit Squadron under the tutelage of Raoul Lufbery on 4 March 1918. The 94th Pursuit Squadron was equipped with secondhand Nieuports and spent their first few weeks flying unarmed patrols until their machine guns were delivered. His first kill occurred on 29 April 1918, and by 30 May, he was an ace. Out of action during July and August due to an ear infection requiring Mastoid surgery, he returned and shot down six aircraft during the last two weeks of September and destroyed fourteen more during October.

Rickenbacker flew his first patrol on 6 May 1918 as wingman to Major Raoul Lufbery. They flew at 15,000 feet and although Rickenbacker, flying in trail, flew through anti-aircraft fire, he observed the flight to have been uneventful when questioned post-flight by his lead. Lufbery then pointed out that:

One formation of five Spads crossed under us before we crossed the lines and another flight of five Spads went by about fifteen minutes later...no more than five hundred yards away. Then there were four German Albatros two miles ahead of us when we turned back and there was another enemy two-seater nearer us than that, at about five thousand feet above the lines. You must learn to look about a bit when you get in enemy line.⁵⁷

In an effort to bolster Rickenbacker's image to the surrounding pilots Lufbery asked Rickenbacker about the shrapnel he received and then went about locating hits on his aircraft. Rickenbacker had received three hits, one in the tail, one in the outer edge of the wing, and one within a foot of his body.

Aerial reconnaissance continued to provide vital information, and Rickenbacker often performed detailed observation of key areas while conducting air-to-ground missions. On 30 September 1918, Rickenbacker was tasked by General Billy Mitchell to locate German trains reinforcing the Montfaucon front. By conducting a three plane night reconnaissance they were able to establish that the Germans were not reinforcing their defenses. An earlier incident occurred where American infantry, devoid of aerial reconnaissance, were drawn into a trap. The Germans permitted them to advance through a number of unoccupied German trench lines and then gassed the over three hundred unprepared Americans. Rickenbacker, aware of this incident, concluded the importance gained through aerial reconnaissance.

One single preliminary airplane flight over this area before beginning the offensive would have disclosed the whole

situation. In fact I believe this function of "seeing for the army" is the most important one that belongs to the aviation arm in warfare. Bombing, patrolling, and bringing down enemy airplanes are but trivial compared to the vast importance of knowing the exact positions of the enemy's forces and "looking before you leap."⁵⁸

During the spring of 1918 the Americans were frequently called upon to conduct operations in support of the infantry and air forces of the British and French. Trench strafing was included in the missions that Rickenbacker flew, and he stated that; "Much of the success of our infantry advances was due to the cooperation of our air forces behind the front and beyond the vision of our doughboys in the trenches."⁵⁹

In early October 1918 Rickenbacker's squadron was taken away from the general orders affecting the 1st Pursuit Group and was assigned to patrol the lines at altitudes below 2,000 feet. The purpose of these patrols was to counter enemy aircraft which were themselves crossing the lines at low altitude. Rickenbacker assigned five aircraft to the first patrol. He flew alone at a slightly higher altitude in a trail position to observe the effectiveness of the new tactics. After destroying an observation aircraft Rickenbacker stumbled upon a flight of eight Fokkers and quickly found himself surrounded. The American patrol expeditiously came to the rescue and in the resulting fight, two Fokkers fell, one of them to Rickenbacker's guns.

On 27 June 1918, all of the American fighter squadrons were transferred from the Toul sector to the Chateau-Thierry region. The Toul sector provided limited engagement opportunities against primarily observation aircraft, whereas numerous German fighters operated in the Chateau-Thierry area. This region pitted the

Americans against the best of the German fighter pilots. The Richthofen squadron, then commanded by Captain Wilhelm Reinhardt, operated from Coincy, which was just north of Chateau-Thierry. It was one of four squadrons within Jagdstaffel No. 1. Each squadron contained seven aircraft and their pilots were well trained, skilled, experienced fighters. Jagdstaffel 2 was commanded by forty-two victory ace Captain Bruno Loerzer, and Jagdstaffel 3 was commanded by twenty-five victory ace Captain Bettenge. During four weeks of fighting within this area the American Group suffered thirty six pilots lost or captured and claimed thirty eight victories.

On 25 September 1918, Rickenbacker assumed command of 94 Squadron and celebrated by destroying two aircraft in one flight while flying alone. Eddie Rickenbacker received the Congressional Medal of Honor, Distinguished Service Cross with nine oak leaves, French Legion of Honor, and the Croix de Guerre with four palms.

Aircraft

Rickenbacker flew aircraft which, although initially inferior to the best the enemy possessed, did provide local parity in their employment. After transitioning to a subsequent fighter, he obtained the vast majority of his success with a fighter which drew parity if not superiority over the threat.

Initially flying aircraft considered obsolete by the current standard, Rickenbacker distinguished himself over the enemy. By the time that Rickenbacker entered combat, the Germans were fielding the fourth generation Fokker D.VII to neutralize the fighter performance superiority of the allies own fourth generation fighters. Equipped with the third generation Nieuport 28, Rickenbacker achieved the majority of his first six victories over German fighters. These

aircraft, which included two Albatros D.V's and two Pfalz D.III, were themselves third generation. Once equipped with the fourth generation Spad XIII, Rickenbacker quickly accumulated victories primarily over fighters. Included in his credited totals with the Spad are twelve of the heralded Fokker D.VII.

The United States promised the allies that it would provide 20,000 aircraft of its own upon entering the war. In reality U.S. pilots relied on the allies for their aircraft. France had discarded the Nieuport for the superior Spad by the time the United States entered the war and the Nieuports were provided to these new squadrons. Rickenbacker reflects the American fighter pilot's dismay of the situation: "None of us in France could understand what prevented our great country from furnishing aircraft equal to the best in the world."⁶⁰ These aged Nieuports suffered structural failure of the wing assembly, resulting from design flaws and extensive combat. It was not uncommon for the wing fabric to come off during a high speed dive or a wing to collapse during hard maneuvering flight. Rickenbacker's bitterness is evident in his statement that; "Many a gallant life was lost to American aviation during those early months of 1918, the responsibility for which must lie heavily upon some guilty conscience."⁶¹

While flying the Nieuport Rickenbacker determined the nature of ideal fighter aircraft characteristics;

The ideal fighting machine is of course one that will outperform every enemy machine in every movement. And there are several kinds of performances that are almost equally valuable in combat fighting. High speed is essential. A rapid climb, the ability to dive without over straining the structure or ripping off the fabric by too sudden a change of direction; a high ceiling, which necessitates high engine power and perfect carburetion; quick maneuverability-all these characteristics combined would make an ideal fighting machine.⁶²

Opportunity for Tactical Innovation

Eddie Rickenbacker's response to the opportunity for tactical innovation, which certainly existed, was a balance between personal techniques and unit tactics. While preferring to fight alone, he did not sacrifice the unit's tactical development. Rickenbacker, after observing numerous pilots crash land upon return from combat missions, instituted a policy in which it was required to fly one circuit at pattern altitude at home field before landing. This policy met with immediate success in reducing what no doubt were hypoxia related accidents. When Rickenbacker became second in command of Squadron 94 he was afforded the opportunity to conduct voluntary patrols at his leisure. He preferred to patrol alone during these missions and he remarked;

I naturally preferred going by myself, for I felt no responsibility for other pilots under such circumstances and I had a much better chance of stealing up close to enemy airplanes without discovery. In formation flying the whole flight is limited to the speed and altitude of its weakest member. Formation flying is very valuable to an inexperienced pilot; but after one has learned to take care of oneself one prefers to go out with a roving commission.⁶³

By the summer of 1918 Rickenbacker observed that the German formations grew from flights of three to five aircraft to formations involving twenty or more aircraft. It was only after observing these German formations that Squadron 94 began conducting large formation training. Rickenbacker strove to gain altitude before crossing the lines and then patrol at reasonable, higher altitude, approximately 16,000 feet. Upon observing enemy aircraft he would consciously maneuver his aircraft to put himself in the sun. With the opportunity for an unobserved entry Rickenbacker often attacked superior numbers in a diving pass with a subsequent disengagement. Conscious of the

capability of two seaters he would dive below the observer's field of fire and complete his firing pass from the blind zone below and aft. He remarked that; "I have always made it a point to avoid a fight unless I can maneuver to get the best advantage."⁶⁴

Training Opportunity

Eddie Rickenbacker eagerly sought training opportunities afforded him. Unlike many of the allies the Americans benefited from the formulation of institutional doctrine and influences in the form of specialized air combat related training. Rickenbacker was keen to recognize certain experiences as a form of training opportunity and was quick to disseminate these lessons. Regarding his training Rickenbacker remarked that: "As I look back upon it now, it seems that I had the rare good fortune to experience almost every variety of danger that can beset the war pilot before I ever fired a shot at an enemy from an airplane."⁶⁵

CHAPTER 6

CONCLUSIONS

Background

The general literature regarding World War I occasionally over romanticizes the aces as knights of the air and hunters of near noble distinction. These references, conjuring up visions of a chivalrous echelon within a caste system, fail to accurately represent the aces' backgrounds. There are three common threads regarding the backgrounds of the World War I aces. First, they were rich in social and economic diversity. Second, education was highly regarded and, finally, the opportunity for athletic competition and personal development was actively sought.

Collectively, the aces' backgrounds cover a broad spectrum. Of the representational figures, Oswald Boelcke and Billy Bishop enjoyed comfortable family conditions while Edward Mannock and Eddie Rickenbacker endured the hardship of losing a father. These losses, due to abandonment and death respectively, resulted in a requirement for supplemental family income. Mannock and Rickenbacker were therefore required to leave school at an early age and enter the work force.

Similarly, Boelcke and Bishop were afforded the luxury of a military education, while Mannock and Rickenbacker wrestled with contributing to their families financial crisis. Again, Mannock and Rickenbacker sought solutions and actively pursued continued

educational opportunities. An aggressive spirit resulting from these experiences is, however, consistent among them.

Most of the aces benefited from prewar athletics or sport and the competition these activities provided. Boelcke, although asthmatic, pursued swimming, diving and climbing, Fonck maintained a constant physical training program almost religiously, Mannock held a passion for cricket and Rickenbacker excelled in auto racing. There were preexisting physical conditions in at least two of the representational figures which would certainly exclude them from modern military flight operations.

Background diversity amongst the World War I aces occurred for two fundamental reasons, initial skepticism of the aircraft's utility and high wartime pilot attrition rates. The aircraft entered the war with limited capability and even more limited confidence. Before the war the aircraft was primarily considered to be a play thing of the social elite. It certainly was not prudent to carry this social association over to combat aircraft. Some of the early combat pilots were experienced aviators of prewar fame although most had no previous flight experience. Nations were forced to rapidly draw from the available manpower rather than usher in a new form of warfare with preset social and economic background requirements. As the war progressed and the lethality of the fighter increased, so too did the casualty rate. Additionally, the resulting demand for replacements increased dramatically. Transfers to the respective air services from other service branches became routine. Screening of wartime applicants appears to have simply consisted of a routine physical examination and determination of an individual's desire to fly and fight. While these two factors created background diversity amongst

the pilots who engaged in air combat, it is evident that success was not dominated by a particular economic or social class.

There were no educational requirements or restrictions placed upon the pilots of World War I. The majority of the representational figures were afforded educational opportunities ranging from solid educational foundations to individually pursued curricula. During World War I these individuals displayed air combat tactics ingenuity which bordered on creative genius. The inference here is not that success was linked with the inherent value associated with a individual's particular studies. However, these studies did produce the mental discipline required to analyze, adapt and succeed in the newly formed, dynamic environment of air combat. Similarly, athletics and sport nurture a competitive spirit required for success in air combat. Additionally, physical conditioning benefits the fighter pilot by offsetting the debilitating effects of aggressive aircraft maneuvering and combat stress.

Combat Environment

Air combat can be generalized into two environmental categories, permissive and dynamic. The difference between the two is the degree of challenge that the fighter pilot faces. In a permissive environment a status quo generally exists with one side maintaining dominance over the other. This dominance, through maintenance of an overwhelming advantage of some form, enables the fighter pilot to conduct his assigned mission relatively unchallenged. While the dominant side's environment is permissive, their adversary's environment is certainly challenging and therefore not permissive. Arguably, it is impossible to have permissive environments on both sides. A dynamic environment contains varied challenges which bring

with them associated risk. Elements of the conflict that these imposed risks may effect range from performance of an assigned mission to survival of the nation. To be successful in a permissive environment simply requires the correct application of an overwhelming dominant factor relatively unopposed. This factor could involve technology, procedures, strategy or some proven combination thereof. Success in a dynamic environment is more closely linked to the capabilities of the individual fighter pilot. The challenges and risks involved require accurate airborne decision making and skilled aircraft employment. Adaptation to these requirements are accomplished through training and experience.

During World War I a permissive environment existed for only a short period of time. With the employment of the Fokker Eindecker and specialized tactics, the German Air Service dominated the skies. This period clearly established the nature of air combat and concluded once the allies responded with superior aircraft and numbers. This allied response increased the challenges faced by the Germans and initiated an escalation in aircraft development, aircraft performance enhancements and air combat tactics and strategy development. Periods of limited air superiority existed in the continuing air combat advantage tug-of-war. However, the combatants continually faced enormous challenges and were therefore never able to return to a truly permissive environment.

The representational figures each fought in a dynamic air combat environment. Of these aces only Boelcke experienced a period of superiority within a permissive environment. Boelcke's air combat environment changed dramatically from the permissive Eindecker patrols to the dynamic with the execution of the allied offensive strategy.

Facing numerical superiority Boelcke responded with tactics development and pilot training.

Factors affecting the environment of the aces varied between combatants. The allied aces routinely flew behind enemy lines as a result of an aggressive, offensive strategy. These aces often faced superior numbers of patrolling defenders and risked capture if forced down. Facing a well-trained and experienced enemy, who was afforded the opportunity of repatriation and continued service if forced down, added an additional challenge. The Germans were able to retain the experience of pilots who survived forced landings, whereas the allies' experience level suffered from their loss.

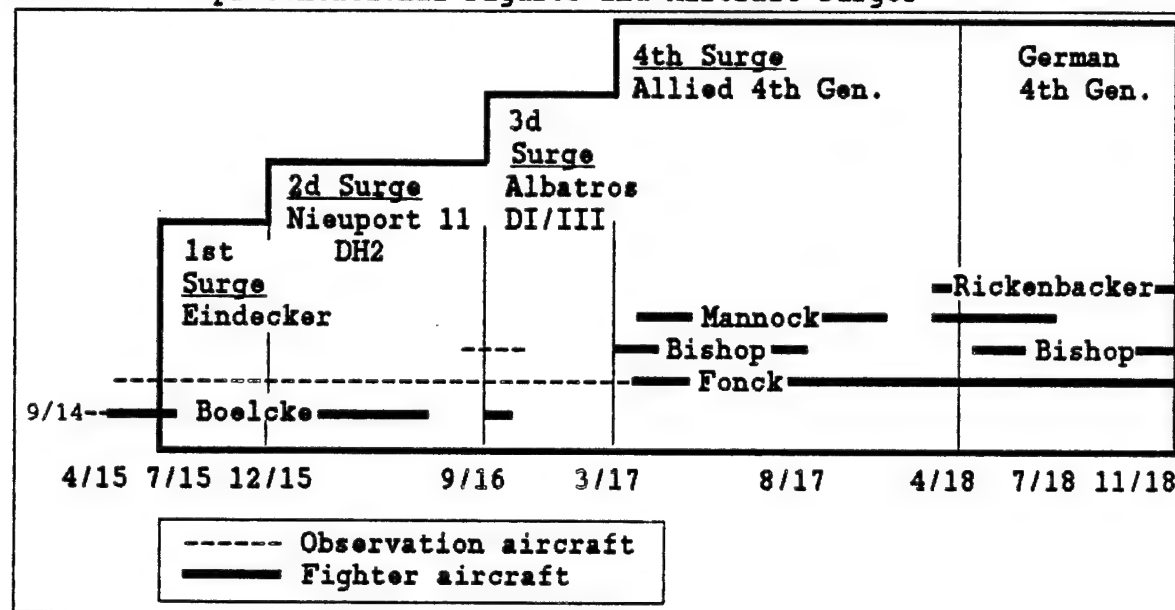
Aircraft

Aircraft which the representational figures flew in air combat were generally equal to if not superior than their adversaries'. The service period of most of these aces corresponds with an aircraft superiority surge of their respective side (see figure 1). The majority, however, did not initially enjoy this advantage. They flew aircraft which could at best achieve performance parity with the finest fighters their adversary could field. After achieving success they eventually transitioned into aircraft generally superior to that of their foes. It was in these that they saw their greatest success.

None of them, with the exception of Rickenbacker, had to contend with the possibility of facing clearly superior aircraft. In his case, the possibility existed to be outclassed by a newly introduced fourth generation Fokker D.VII while flying his third generation Nieuport 28. It was fortuitous for him, however, that this did not occur. He generally faced local threats on par with the Nieuport until subsequently equipped with the fourth generation Spad

XIII. In comparison, Boelcke fought in first (Eindecker) and third (Albatros D.I, D.III) performance surge conditions while remaining absent from air combat during a significant portion of the second (DH 2/Nieuport). Boelcke fought from a general position of aircraft performance superiority.

Table 1. Representational Figures and Aircraft Surges



Opportunity for Tactical Innovation

The opportunity for air combat tactical innovation existed during World War I and was seized by the aces. Tactical innovation was an open forum devoid of institutional restrictions and direction. Limited only by imagination the aces responded to this opportunity in two sharply contrasting forms: that of the individualist and that of the leader.

The individualists, such as Rene Fonck and Billy Bishop, neglected formation tactics and concentrated instead on personal air combat. Formation tactics, although powerful, were extremely difficult to coordinate and control. Without the aid of an airborne

radio flight leaders relied upon visual signals and preplanned tactics. This required extensive preparation and training, both extremely limited, and often resulted in a melee after the first pass anyway. Surprise, a highly sought principle of war, was difficult to achieve while orchestrating a large formation attack. The performance qualities of the World War I fighters additionally complicated the endeavor. The limited excess power that their engines provided was often not enough to enable inexperienced wingmen to maintain a strict formation. It was not uncommon for wingmen to fall far behind their maneuvering leader. Therefore, it was concluded that it was much easier to individually stalk an enemy formation, gain an undetected entry for a close range shot, and then execute a preplanned escape maneuver.

Possessing excellent marksmanship and flying skills, these aces pursued personal tactics development that profited the single, unobserved fighter. Generally, this initiated with a climb to the individual aircraft's highest obtainable altitude. Each of these aces had their own patrolling philosophy and engagement criteria. However, their perfected attacks were quite similar. Once committed, they would conduct a high speed dive to arrive, unseen, into a firing position. Most of the aces, although accomplished marksmen, closed to extremely close range before firing. Upon completion of the attack they would generally opt for an escape however individual engagements against superior odds was not uncommon. One advantage that they had in these circumstances is that every other aircraft involved was a target.

Air combat, for these aces, was individualistic with little effort made towards coordinated formation tactics. This style of

fighting was typified by the French Air Service, coincidentally the first country to implement the ace recognition system. Additionally, these aces provided very little to the tactical development of their junior pilots. Seemingly, they were role models without the substance required to effect change. Although rewarded with scores of victories and recognition, the tactical development of their respective squadrons and air services suffered from their inattention.

The leaders, such as Oswald Boelcke and Edward Mannock, had a clear vision of air combat beyond the confines of their individual cockpits. They recognized the advantages of cooperative formations of fighters in air combat and the resultant requirement for tactics development and pilot training. This realization often occurred without precedence. Formations of World War I fighters enhanced mission accomplishment through maximization of firepower while increasing survivability through mutual support. The difficulty in reaping these benefits was manifested in tactical execution. As described earlier, the combat success of fighter formations relied heavily upon tactics and training, both of which required development. The individualists had only to achieve individual skills whereas the leaders had to additionally create mission oriented formation tactics while developing viable unit training.

Eddie Rickenbacker bridged the gap between the leaders and the individualists. Preferring to fight alone, he was still fully cognizant of the requirement to conduct and lead multi-plane, coordinated attacks. His attention, while perhaps not evenly divided, did find a balance between unit and personal tactical innovation.

The mission-oriented vice reward-oriented approach had profound, influential affect upon air combat through the Second World

War. Although the individual success of the leaders profited by the exploitation of this opportunity, these aces' greatest contributions were to their respective units and air services. The record of 85 Squadron, RAF testifies to the greater significance of the leaders over that of the individualists. Under the command of Bishop, 85 Squadron was a unit of individuals with the vast majority of its claims made only by their commander. After Mannock assumed command of 85 Squadron from Bishop the squadron, in one short month, accounted for ninety victories with only two losses. Eight of these victories were personally accredited to Mannock.

Training Opportunity

The opportunity to train, although complicated by the pace of change and lack of institutional direction, certainly existed and was exploited by the aces. While a revolution in fighter aircraft performance and air combat tactics development occurred during World War I, pilot training failed to keep pace. The flight training of the early pilots, provided by the respective air services, consisted primarily of basic flying requirements. It was late in the war that specialized pilot training was established at the institutional level, taking form in an equivalent of today's fighter weapons schools. Prior to this the responsibility for pilot training rested solely upon individuals within the fighting units. It was this training opportunity at the front that the aces influenced.

A curious, unexpected balance was produced between precombat training and experience. Mortality rates of the World War I pilots were complicated by limited training and experience. The representational figures unknowingly achieved a marriage between experience and training which contributed to their success. Early on,

experience supplemented inadequate training while later, relevant training provided much needed experience. Boelcke, Fonck and Bishop were afforded the opportunity to gain flight experience prior to their participation in extensive air combat. This significantly influenced their success in the absence of sufficient training. Alternately, Rickenbacker enjoyed relevant air combat training before assignment to the front which provided him the requisite experience that he required. Mannock, however, was afforded neither of these opportunities and therefore pursued a highly criticized personal training program to gain experience.

While all of the representational figures took advantage of training opportunities at the front, this training was closely linked to their tactical philosophies. The individualists preferred independent training such as aerial gunnery to hone their personal skills. The leaders and true tacticians sought not only training opportunities for themselves, but also the development and implementation of unit training. This training consisted of specified conditions which included preflight briefs, post-flight debriefs and dedicated analysis and understanding of the tactics employed. These training philosophies expanded within their spheres of influence.

Summary

External factors, interwoven with personal attributes and luck, produces a tapestry of air combat success. The construction and weave varies and is not preordained. Certainly, there were World War I fighter pilots who mirrored these external factors without success. This study has merely served to shed light upon common threads relevant to World War I air combat.

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